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Electrical World

SEPTEMBER 1, 1945

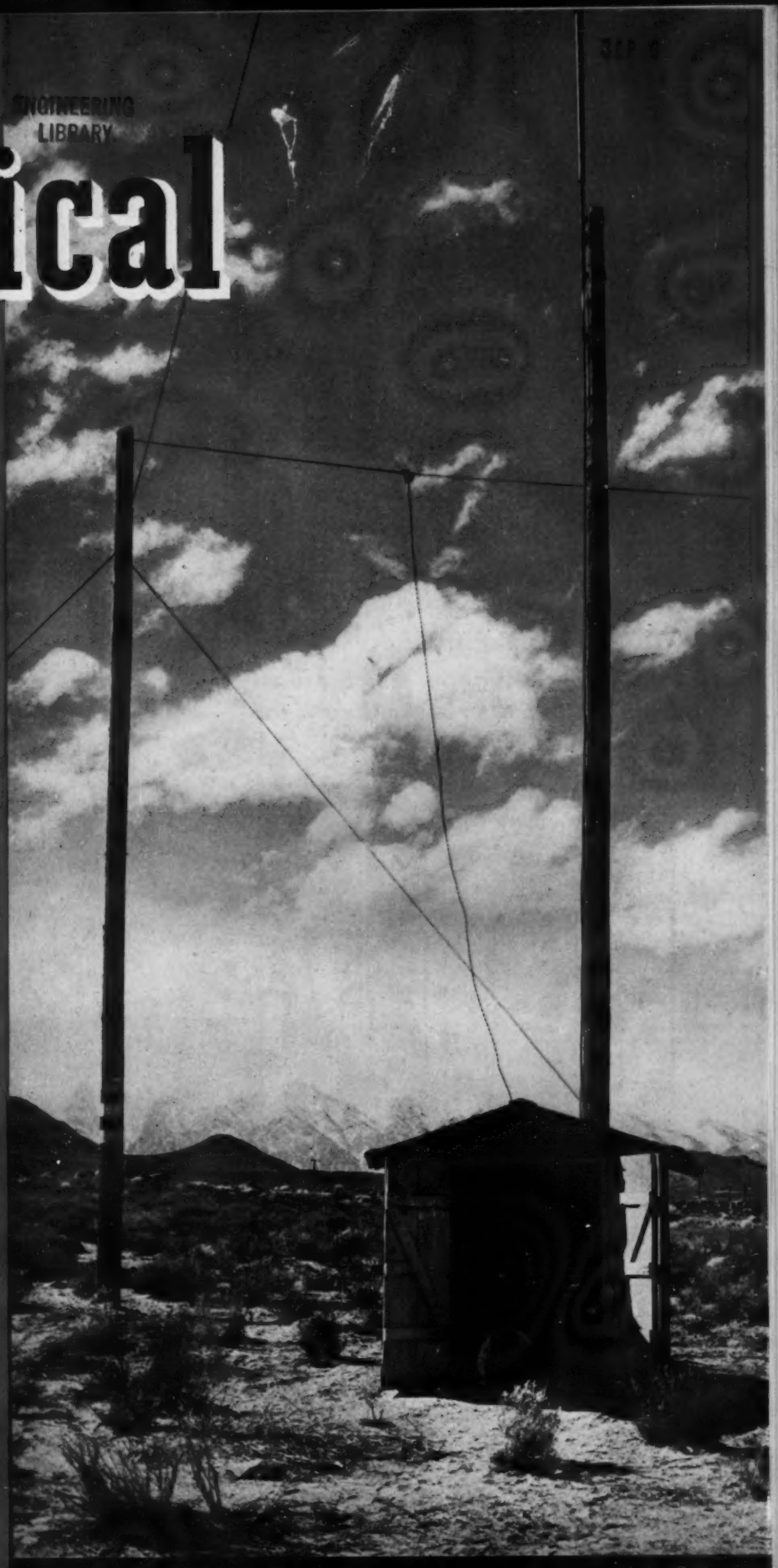
Dielectric Heating in Industrial Processes

Use of Two-Way FM Radiotelephone for Difficult Communication Areas

Computation of Transformer Insulation Deterioration

Gas Turbine for Ship Drive and Packaged Power

Traveling Shop for Substation Maintenance



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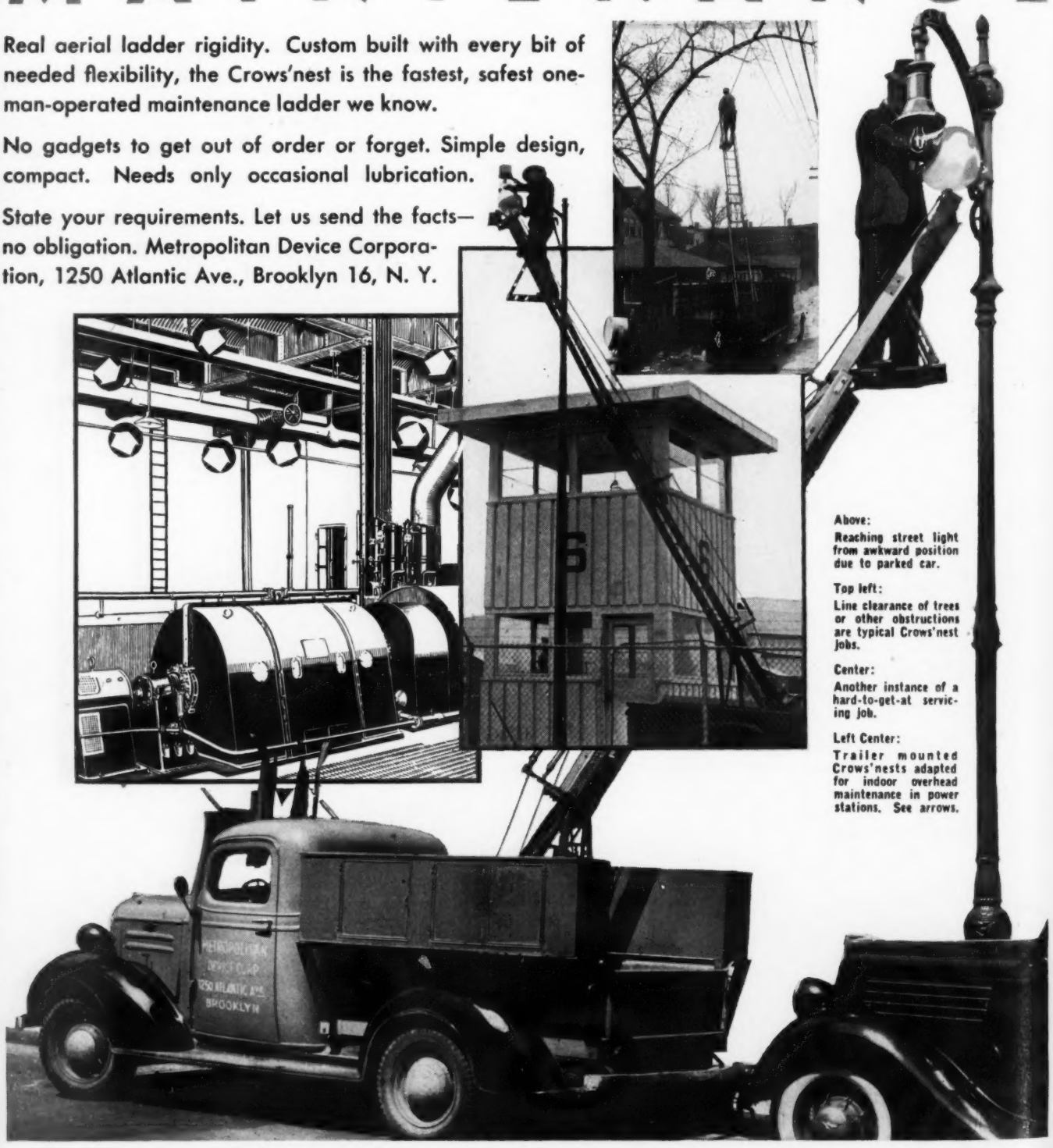

Above:
Reaching street light from awkward position due to parked car.

Top left:
Line clearance of trees or other obstructions are typical Crows'nest jobs.

Center:
Another instance of a hard-to-get-at servicing job.

Left Center:
Trailer mounted Crows'nests adapted for indoor overhead maintenance in power stations. See arrows.

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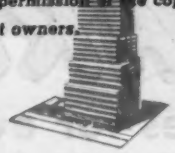

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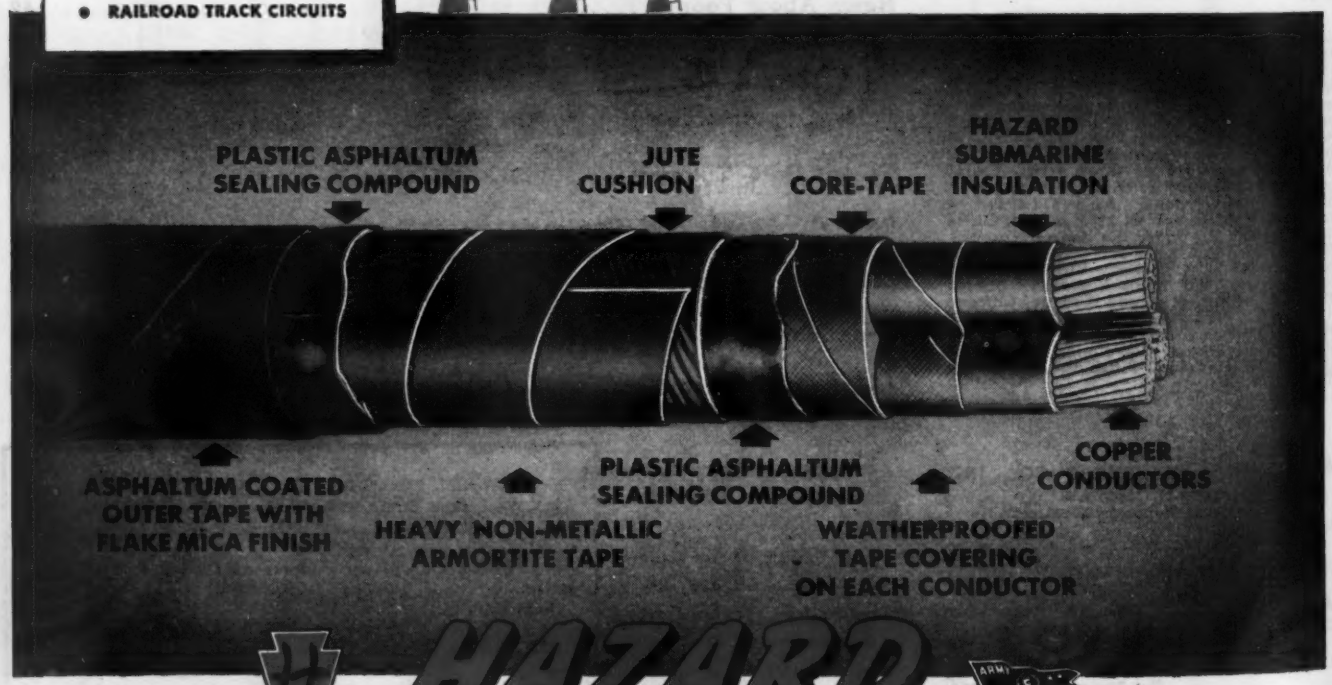

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Electrical World
SEPTEMBER 1, 1945

Now Begins the Test

COMING MUCH SOONER than had been expected, the end of the war has brought the nation with dramatic suddenness hard up against the thorny realities of converting to peace. Post-war is now, its problems no longer a matter of analysis and debate as things of the future but an affair of immediately demanding urgency.

On success or failure to solve the problems of conversion to the satisfaction of the people depends more than has ever hung upon the actions of labor and of business. Not just advantage and improvement of its lot to labor, not just profits to business, but very probably actual survival of a form of society depends on how well or how ill labor and business acquit themselves in the time now beginning.

Now practically alone among the nations in its adherence to the principles of a free economy, this country gives individual enterprise what well may be its last chance to prove its claimed superior values in the modern world.

Two dangers lie ahead. One is in the winds of inflation that first will speed our course but soon turn into a storm to wreck us. The other is in the deadly calm of thwarted enterprise where the spirit of mutiny will grow apace.

Exercising the authority of continuing war agencies, government is trying to prevent inflation and at the same time to encourage enterprise. Both labor and business should cooperate in that effort and in the main are doing so according to their lights. But their lights are not wholly the same and disagreements arise inevitably.

We see those disagreements on every hand. Labor demands employment as a right and at any cost, and simultaneously insists on the same take-home pay it enjoyed during the war. Business protests that between its costs, in which labor is a large part, and the price of goods set by government to prevent inflation, there is no room for profit without which it cannot function and grow.

Each of these contentions is right if not pushed too far, when both become horribly wrong.

Labor must realize that it can earn more in reasonably low prices than it can in unreasonably high wages. Business knows well and must apply more diligently than ever the principle that profit does not lie in how much prices are higher than costs but in how much costs are lower than prices. The viewpoint makes all the difference.

The problem is vastly more complicated than appears in this short discussion. Included in it are many more factors than are mentioned here. There is no formula for its solution. But there are means by which it can be solved. They are intelligence, reason, honesty, good faith, and, above all, a disposition to see the other side of the argument and a willingness to cooperate.

This is the test before us. Will it prove that the compromises of democracy are a better producer of what men want from life than are the formulas and prescriptions of a regimented society? It will if the compromises are fair, if they are not arrived at from the clashes of stubborn and aggressive minds, but result from the amicable sharing of ideas among men of good will.

Gas Turbine for Ship Drive and Packaged Power

Unit of 2,500 hp. developed by U. S. Navy and the Elliott Co. for propulsion—Major factor is new positive displacement compressor—Mounting is heat-elastic to combat high gradients—Starting is reported simple—Package power units on similar pattern, virtually outdoor plants

EVOLUTION of a positive-displacement compressor, successful search for high temperature alloys and adoption of a heat-elastic assembly were major factors in development of the Elliott gas turbine (Fig. 1) which the U. S. Navy Bureau of Ships and the Maritime Commission are applying to ship propulsion. Significant details of the experimental 2,500-hp. unit which has been undergoing tests at the Elliott Co.'s plant are here recorded for their bearing on the progress toward attaining units for stationary power generation in customary utility sizes. This achievement is asserted still to be several years away but a packaged-power plant is stated to be part of the program founded on the present units for the Navy and Merchant Marine.

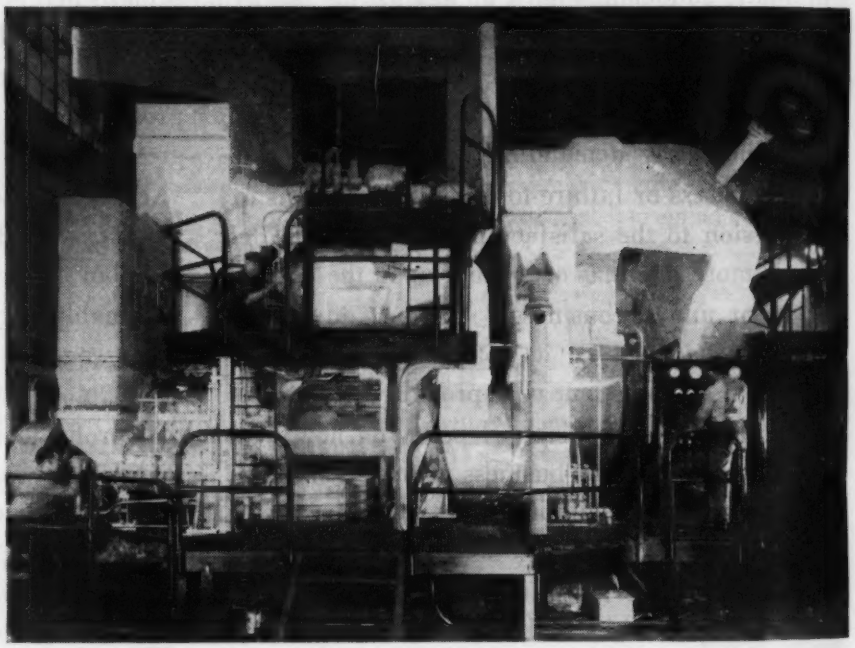


FIG. 1—Designed for 100,000 hours of ship-propulsion service this 2,500-hp. gas turbine has a thermal efficiency of 29 percent

Fixing the Cycle

A regenerator has the greatest single effect in raising the efficiency of the gas turbine plant. Addition of an inter-cooler and a second combustion chamber and turbine also increase the expected economy (Fig. 2). Use of still another stage of intercooling and reheat are also shown to be advantageous but, as is seen, the gains are becoming progressively smaller. However, as the number of elements are increased they become reduced in size, and are consequently easier to build.

That is why the Navy unit is composed of two turbines, two compressors with intercooling, two combustion chambers, and a regenerator (Fig. 3).

The low-pressure compressor takes in free air and compresses it to a pressure of 43 psi., and 300 deg. F. The temperature is then lowered in the intercooler, whereupon the air passes directly into the high-pressure compressor which raises the pressure to 96 psi. absolute. The air then passes through the regenerator, where a portion of the heat in the exhaust gas is recovered before it enters the high-pressure combustion chamber.

Temperature is 1,230 Deg. F.

In the high-pressure combustion chamber, fuel oil is burned directly in the air stream and a temperature of 1,230 deg. F. is reached at the entrance to the high-pressure turbine. In this turbine the heated air is expanded to 53 psia., and in doing so sufficient power is developed to drive the low-pressure compressor.

The air from the high-pressure turbine exhaust is then reheated in the low-pressure combustion chamber to elevate its temperature to 1,207 deg. F. before it is expanded in the low-pressure turbine. Five thousand horsepower is realized from the low-pressure turbine, 2,500 hp. of which is expanded in driving the high-pressure compressor. The remainder is excess power which, in this marine gas turbine, drives the propeller.

After the air leaves the low-pressure turbine at slightly above atmospheric pressure, it passes to the regenerator where it pre-heats the fresh compressed air from the high-pressure

compressor. The exhaust gas passes up the stack at a temperature of 400 deg. F. and is discharged to atmosphere.

Rotary Compressor

A major requirement of the efficient production of power by gas turbines was a means of compressing large volumes of air economically. The Lysholm compressor (Fig. 4) combines the advantages of a reciprocating compressor and those of a strictly rotary machine. It has only two moving parts and these are of exceptionally rugged construction.

At the high speed, it inhales successive bites of air which are enclosed, cut off and compressed by squeezing, and finally expelled into the exhaust system. At both the intake and exhaust the successive bites overlap so that a continuous flow is obtained.

This is a positive displacement machine which for each turn of the shaft takes in and compresses a fixed volume of air independent of the back pressure imposed. Over a very broad range the operating pressure can be independent of air quantity and this has the practical effect of allowing selection of a flow-pressure relationship exactly suited to the associated turbines.

Temperatures are very high and the turbines had to be made from materials which have a coefficient of expansion 50 percent higher than ordinary steel. Since the turbines are nearly ½-in. longer at operating temperature than when they are cold it was necessary to design these machines, their mountings, and all parts connected to them in such a way as to permit these expansions to take place in a short space, without pushing the machines from their foundations or breaking the connecting pipes. In order to permit expansion it was necessary to secure the float-

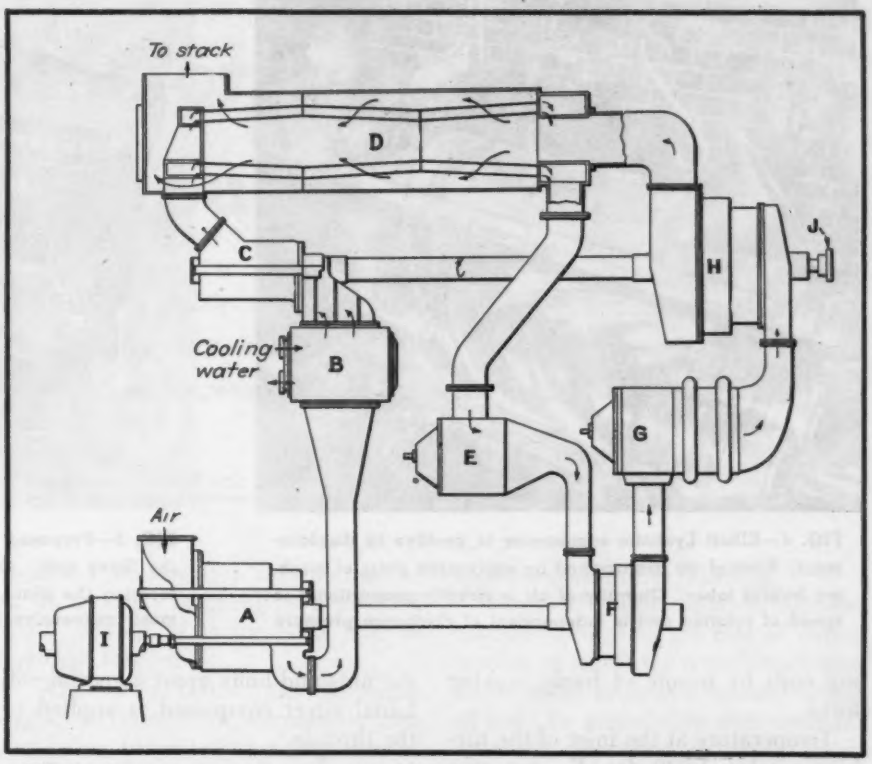


FIG. 3—Arrangement of components of 2,500-hp., gas turbine plant: A, low pressure compressor; B, intercooler; C, high pressure compressor; D, regenerator; E, high pressure combustion chamber; F, high pressure turbine; G, low pressure combustion chamber; H, low pressure turbine; I, starting motor; J, output shaft

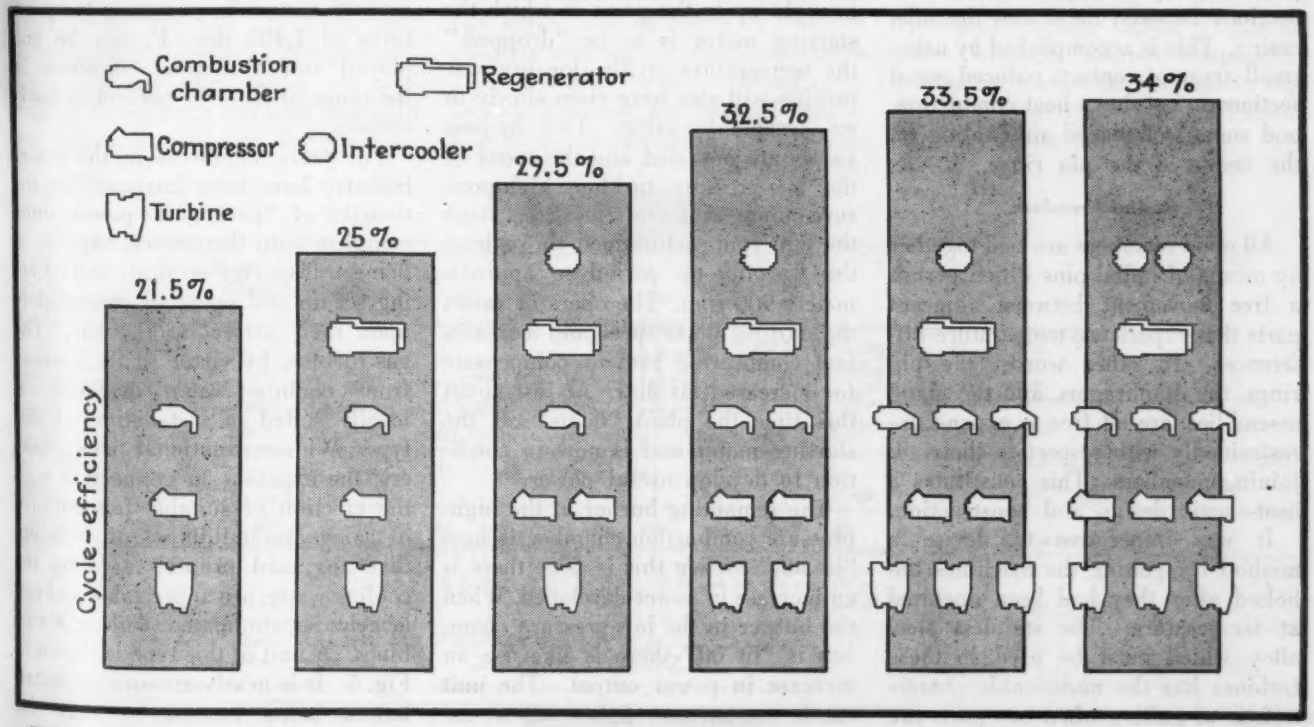


FIG. 2—Analysis of practical combinations of gas turbine elements led to decision to employ two turbines, two compressors (with intercooling), two combustion chambers and a regenerator

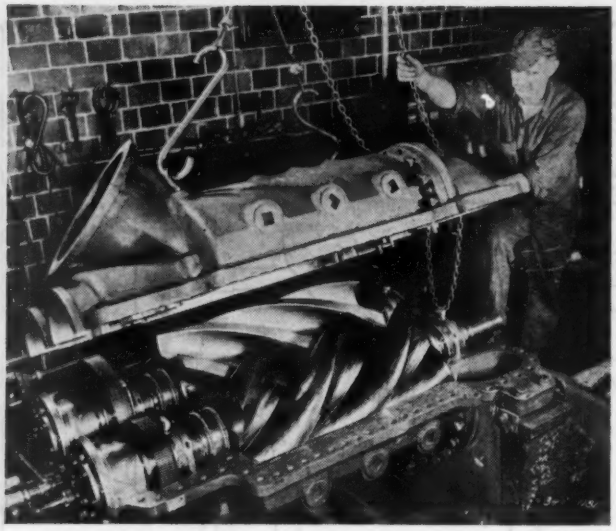


FIG. 4—Elliott Lysholm compressor is positive in displacement. Bites of air are trapped by successive pairs of meshing helical lobes. Quantity of air is directly proportional to speed of rotation and is independent of discharge pressure

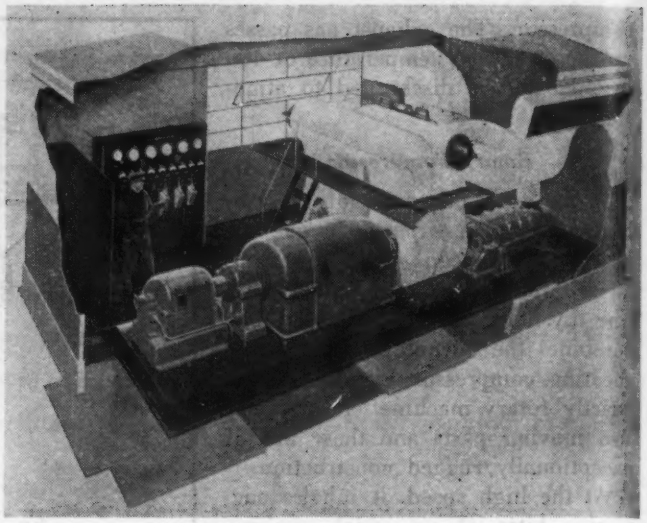


FIG. 5—Proposed packaged power unit is simplified form of the Navy unit. Cooling water problems may be forgotten in locating the plant. Being virtually an outdoor unit, only the most inexpensive housing structure is required

ing ends by means of freely moving links.

Temperature at the inlet of the turbine reaches 1,230 deg. F.—yet at a point approximately 10 in. away, the metal temperatures must be below 200 deg. F. for proper operation of the main shaft bearings. To restrain the free conduct of heat to undesired locations resulted in the use of heat dams and special oil cooling at the bearings, and air cooling at the pin rings were used. The latter are so constructed that a 600-deg. F. temperature drop takes place in the connections between them and the inlet casing. This is accomplished by using small areas of contact, reduced metal sections to cut down heat conduction, and some well-placed air cooling on the inside of the pin rings.

Radial Freedom

All main members are tied together by means of radial pins which permit a free movement between adjacent parts that experience temperature differences. In other words, the pin rings, the diaphragms, and the gland assemblies, are all free to expand unrestrainedly with respect to their adjoining members. This constitutes a heat-elastic design and construction.

It was imperative to devise a method for getting the machines unbolted after they had been operated at temperature. The stainless steel alloy which must be used in these turbines has the undesirable characteristic of galling when two parts are assembled together. To be able to take the nuts and bolts apart a special colloidal silver compound is applied to the threads.

Starting is Simple

Starting is quite simple and brief. It is only necessary to engage the starting motor, light off one burner and warm up. The operator, having all operating conditions visibly indicated on the control panel, correctly controls the rate of warm-up by variation of the throttle lever.

When the inlet temperature to the high-pressure turbine has been *slowly* brought up to the point at which the starting motor is to be "dropped," the temperature on the low-pressure turbine will also have risen slowly to an acceptable value. Two by-pass valves are operated and the speed of the low-pressure turbine, high-pressure compressor shaft increases from the 250 rpm. maintained throughout the warming-up period to approximately 900 rpm. The operator raises the starting motor speed and increases fuel combustion rate to compensate for increased air flow. At just about this time the plant "floats" off the starting motor and is now in condition to develop useful power.

The remaining burner in the high-pressure combustion chamber is now "lit off." When this is done there is an increase in power developed. When the burner in the low-pressure chamber is "lit off" there is likewise an increase in power output. The unit can be run on very light loads by using only the one burner in the low-pressure chamber but this is yet to be investigated thoroughly.

From the time the starting motor has been detached the amount of power output realized in all subsequent settings of the controls is merely a *function of combustion rate* and low-pressure turbine speed.

Later Versions

A later version (again a 2,500-hp. propulsion unit) has been designed to operate on the same cycle as the present experimental plant with reheating intercooling and regeneration. With modern materials, operating temperatures of 1,400 deg. F. can be employed and a thermal efficiency in the range of 32 to 34 percent is fairly certain.

For years, engineers in the power industry have been intrigued by the thought of "packaged" power units complete unto themselves, capable of being transported on skids and of being set up and operated immediately upon their arrival at the site. The gas turbine, by virtue of its freedom from cooling water demands, is ideally suited to installation of this type. With conventional prime movers, the expenses in connection with the erection of suitable foundations, of adequate buildings, of locating, diverting, and properly treating the cooling water, are appreciable and can largely be eliminated with gas turbines. A unit of this type is shown in Fig. 5. It is nearly an outdoor installation, being housed by only the cheapest frame structure.

Aging of Transformer Insulation Computed

Cumulative aging, temperature rises and hot-spot values determined from composite rule based upon the accepted principles of thermal behavior of temperatures under various ambients and cyclic loadings

M. H. PRATT, Electrical Engineer, Central New York Power Corp., Syracuse, N. Y.

ECONOMIC ADVANTAGE resulting from intelligent use of the information about loading transformers in keeping with their thermal capabilities which has been built up (particularly during the war) can be far reaching. In fact, the field of further advance would now seem to be largely in improving the tools or methods already provided for estimating temperatures, permissible overloads and loss of equipment life through deterioration of insulation.

As a contribution in this direction a slide rule has been devised to facilitate the calculations commonly required for such determinations. It is fast in operation and easy to read to the required accuracy. It is more facile than the use of charts and averts the interpolations that are usually necessary when tables are consulted. Experience has been had with the particular design described to warrant the assertion that its use for a wide variety of problems concerned with loading to temperature can be quickly learned.

Whether a transformer is being aged at faster than normal-life rate by being subjected to a sequence of loadings, some of which are substantially above rating, can be determined in a step-by-step procedure which takes account of intervening cooling.

Aging Scale

The rule is 10 in. long and has two slides, nine scales and a runner or indicator (Fig. 1). There are two scales for ambient temperature (both deg. F. and C.). The top slide has an arrow marked "Set to ambient" and two scales, one of which (C) shows absolute winding hot-spot temperature (deg. C.) and the other the adjacent D-scale showing the rate of insulation aging corresponding to any hot-spot temperature of winding.

Value "1" on this D-scale indicates normal aging, i.e., the rate of deterioration at which the transformer may be expected to have a normal length of life. In accordance with accepted standards this rate of aging is related to the established hot-spot temperature of 95 deg. C. as a point of reference. The values on the D-scale were determined from the relation—

$$\left.\begin{array}{l}\text{Hours of normal life expended}\\ \text{per hour of operation at hot-}\\ \text{spot temperature T deg. C.}\end{array}\right\} = \frac{e^{0.0693T}}{3{,}645}$$

Temperature-Rise Scales

Center body-section of the rule has three scales which relate temperature rise to loadings. Bottom (A) scale has loads expressed in percent of nameplate rating. Center (E) scale gives winding hot-spot temperature rise above top oil temperature in deg. C. for any corresponding load shown directly below on the A-scale. The

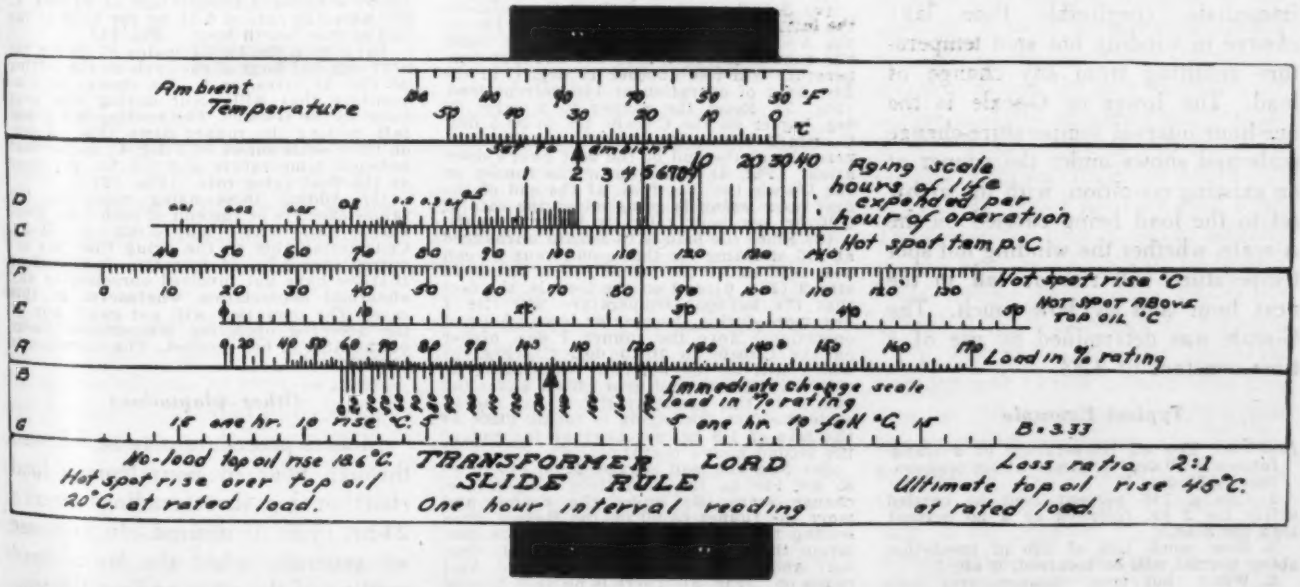

Ambient Temperature
°F
°C
Set to ambient
Aging scale
hours of life expended per hour of operation
Hot spot temp °C
Hot spot rise °C
Hot spot above top oil °C
Load in % rating
Immediate change scale load in % rating
B-333
No-load top oil rise 18.6°C.
Hot spot rise over top oil 20°C. at rated load.
TRANSFORMER LOAD SLIDE RULE
One hour interval reading
Loss ratio 2:1
Ultimate top oil rise 45°C. at rated load.

FIG. 1—Nine-scales and runner on 10-in. slide rule for transformer loading, temperature and aging calculations

values shown are for transformers without forced circulation or ventilation.

Top (F) scale gives the ultimate winding hot-spot temperature rise above ambient temperature in deg. C. for a corresponding load on the A-scale. For example, over 100 on A-scale read on E-scale the indication that at 100 percent of nameplate rating the hot-spot winding temperature will be 20 deg. C. above the top oil temperature. This difference can be assumed as taking place with negligible time lag. Also, above 100 on the A-scale read on the F-scale the fact that, *if* 100 percent of nameplate rating load is maintained until equilibrium is reached, the ultimate winding hot spot temperature reached will be 65 deg. C. above the ambient air temperature.

These three central body scales just described above are simply line coincidence scales and were figured using the basic assumptions of 2 to 1 loss ratio at rated load (2 copper to 1 iron); variation of ultimate top oil rise above ambient proportional to the 0.8 power of the total losses; ultimate top oil rise above ambient at rated load 45 deg. C.; variation of hot spot rise over top oil proportional to the 1.6 power of the load; and hot-spot rise of 20 deg. C. over top oil at rated load.

Other Temperature Scales

Two scales and a setting arrow are provided on the bottom slide. Upper scale (B) is graduated in percent nameplate rating and gives a means of shifting the runner to correct for the immediate (negligible time lag) *change* in winding hot spot temperature resulting from any change of load. The lower or G-scale is the one-hour-interval temperature-change scale and shows under the runner at an existing condition, with the arrow set to the load being carried on the A-scale, whether the winding hot spot temperature will rise or fall in the next hour and by how much. The G-scale was determined by use of a time constant of 3.33.

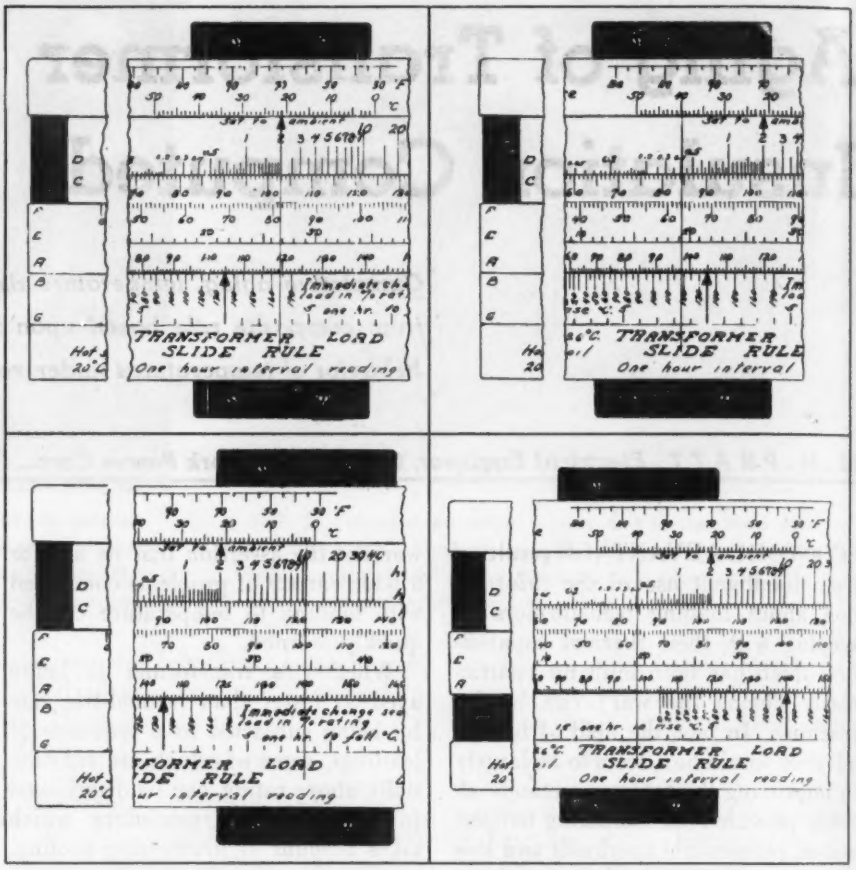
Typical Example

Problem: Top oil temperature of a transformer is 50 deg. C. Ambient air temperature is 70 deg. F.

1. Can a 140 percent load be carried safely for 2 hr. followed by a 90 percent load for 3 hr.?

2. How much loss of life of insulation above normal will be incurred, if any?

3. What hot-spot temperatures are reached?



FIGS. 2-5—Successive settings for steps (a), (b), & (c) of assumed example

Solution:

(a) Set the runner to 70 deg. F. on the ambient temperature scale and the arrow on the top slide to the runner. (Fig. 2)

(b) Set the runner to 140 on the A-scale and read 34.5 deg. C. hot-spot rise above top oil under the runner on the E-scale. (Fig. 3) Add this 34.5 deg. C. to the given top oil temperature of 50 deg. C. giving 84.5 deg. C. as the starting hot-spot temperature. Set the runner to this value 84.5 deg. C. on the C-scale. (Fig. 4) (Note: this setting of the runner gives the "starting" hot-spot temperature because *this* temperature will be reached with *negligible* time lag after the 140 percent load comes on).

Aging

(c) Set the arrow of the lower slide to the initial load of the proposed cycle 140 on the A-scale and read on the G-scale under the runner the fact that the hot-spot temperature will rise another 10 deg. C in the first hour of operation at 140 percent load. (Fig. 5) Reset the runner to a value 10 deg. higher on the C-scale, i.e. to 94.5 deg. C., which will be the hot-spot winding temperature at the end of the first hour's operation. (Fig. 6) Read under the runner on the D-scale the fact that, at the end of the first hour, aging is going on at the rate of 0.96 hr. per hour (slightly below normal).

(d) Since the load is to remain unchanged at 140 of rating for the second hour we can now read under the runner, as it stands in step 3 (Fig. 6) and on the G-scale, the fact that the hot-spot temperature will rise 7 deg. more during the next or second hour of operation. Move the runner 7 deg. higher on the C-scale to 101.5 deg. C. (Fig. 7) which will be the hot-spot temperature at the end of the second hour. Read under the runner in this position (Fig. 7) on the D-scale the fact that aging is taking place at the rate of 1.8 hr. per hour at the end of the second hour's operation.

(e) Now the load changes from 140 to 90 so set 140 on the immediate temperature-change scale (B) under the runner and move the runner to 90 on the B-scale, thus setting the runner to the temperature condition that will exist (with negligible time lag) and as soon as the 90 percent load comes on. (Fig. 8) There is no need to *read* this setting result on the C-scale.

Hot-spot Temperatures

(f) Now move the lower slide arrow to the new load being carried, i.e. 90 on the A-scale and read on the G-scale a further fall in temperature of 1.5 deg. C. during the first hour of operation at 90 percent load. (Fig. 9) Reset the runner down 1.5 deg. on the C-scale showing a hot-spot temperature of 82 deg. C. at the end of the third hour of the proposed cycle and an aging rate at the same time on the D-scale of 0.34 hr. per hour. (Fig. 10)

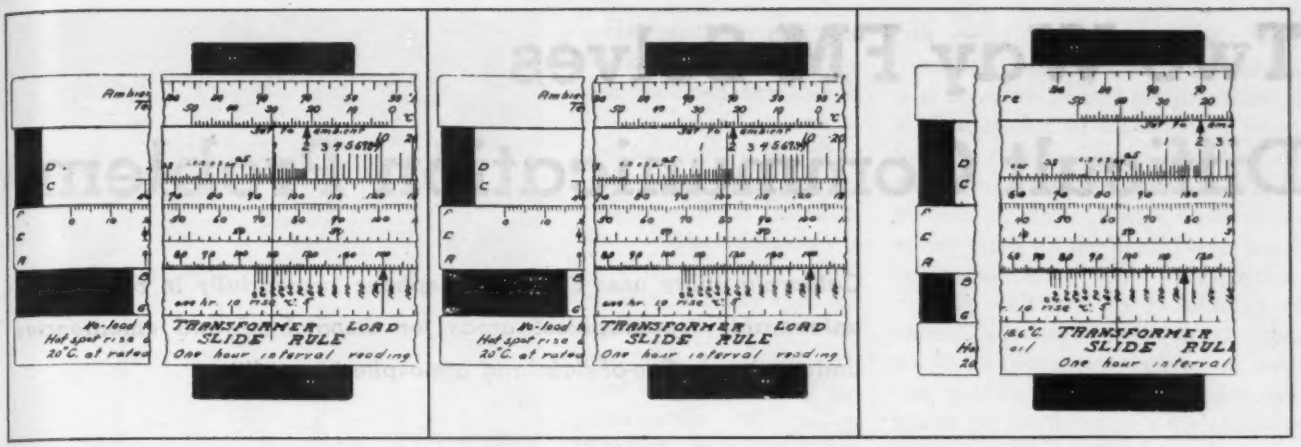
(g) Since the load remains unchanged at 90 for the next hour the value on the G-scale now under the runner in Fig. 10 of 1 deg. is the fall that will occur during the next, or fourth, hour of the cycle. Setting the runner down this 1 deg. on the C-scale shows a hot-spot temperature of 81 deg. C. and an aging rate of 0.31 hr. per hour at the end of this fourth hour. (Fig. 11)

(h) Again the load remains at 90 for the next and last hour of the cycle so the setting of Fig. 11 gives, as is, the change in temperature that will occur during this next hour on the G-scale. The reading is 0.5 deg. fall. Setting the runner down this 0.5 deg. on the C-scale shows 80.5 deg. C. as the final hot-spot temperature and 0.3 hr. per hour as the final aging rate. (Fig. 12)

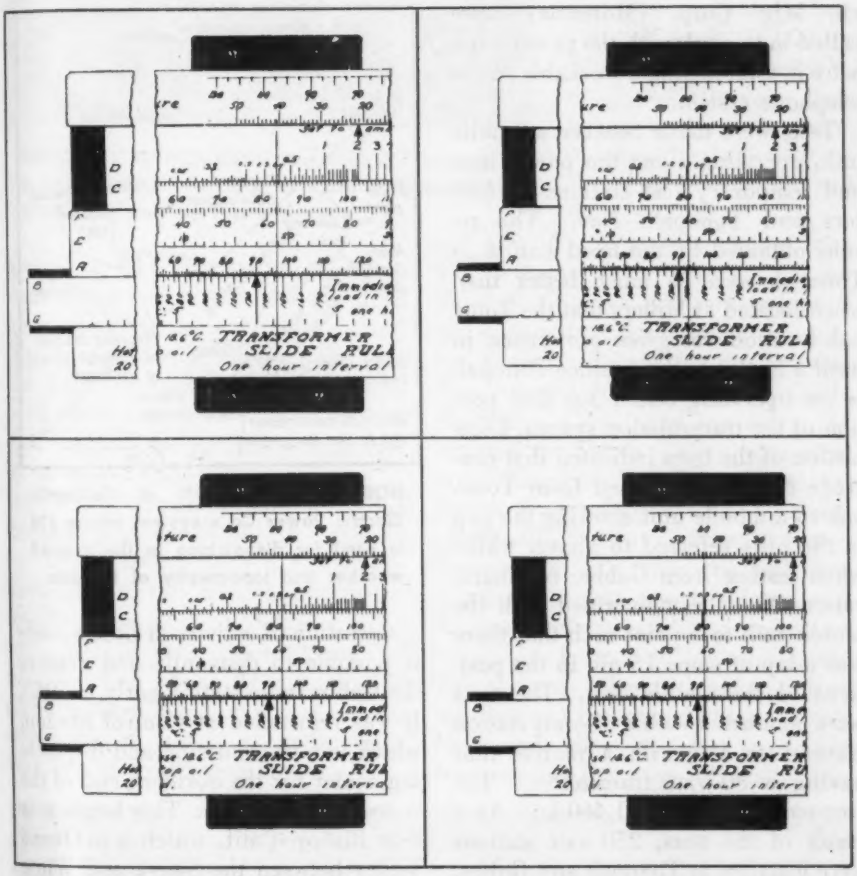
(i) Adding these aging rates for the values effective at the end of each hour gives $0.96 + 1.8 + 0.34 + 0.31 + 0.3 = 3.71$ hr. Considering this as the aging that has occurred over 5 hr. of operation, it is evident that we have not involved ourselves in any abnormal depreciation whatsoever in this case. The operation will not cause any of the accepted operating temperature limits of the ASA to be exceeded. The operation is entirely safe.

Other Adaptations

Similar procedure may be followed through hour by hour from a load chart or log sheet readings over a 24-hr. cycle, if desired. In this case we generally select the lowest load reading of the cycle and set the run-



FIGS. 6-8—Further settings on the slide rule for determining the temperature rise and aging of transformer



FIGS. 9-12—Additional settings of rule for hot-spots and aging at subsequent loads

ner to this value on the A-scale for the starting point proceeding from there in the manner described in detail above.

If desired, and if the figures are known, or the refinement warranted, the upper slide can be reset as necessary to take into account any changes of ambient air temperature which may occur during the load cycle.

In arriving at a measure of the total aging taking place over a cycle we usually simply add the aging readings obtained from the rule for the end of each hour throughout the cycle as in the above example. Further refinement is not usually necessary or justifiable. Obviously the readings of the rule really give the temperature and aging rate at an instant of time only. On rising hot-spot temperatures the *actual* aging that has taken place *during* an hour past will be less than the rate at the end of the hour, the reverse being true on falling temperatures.

If further refinement is desired, the instantaneous aging values read from the rule may be plotted as a curve against time and the actual aging over the period or cycle determined more accurately by integration methods. If this is done in the case of the example above, the actual aging over the 5-hr. operation comes out as 3.33 hr. of normal aging as against the value of 3.71 hr. obtained by simple addition of readings. The addition method is of course simple and normally, as in this example, gives a little more conservative answer.

Other Characteristics

It is, of course, easy for any desired assumptions other than those given above to be used in setting up the scales of such a rule thus obtaining a rule applicable to any desired transformer characteristics. The basic thermal formulas themselves are now well established and widely used. The particular characteristic values entered in these formulas and used for determining the scales of this rule are such as to be conservative for the majority of modern power transformers, thus giving the rule as shown the widest possible application. For example: Time constants will rarely be outside a lower limit of about 2.5 hr. and an upper limit of 7 or 8 hr. The higher the time constant actually is, the less the aging will be over a cycle having peaks over nameplate rating. Use of 3.33 as time constant on a rule is increasingly conservative for any values greater than this and the difference is quite negligible for values of 3 or even 2.5. Similar comparative analysis will show that two to one loss ratio is sufficiently safe to be adapted to transformers whose actual ratio is from one to one to three to one.

Two-Way FM Solves Difficult Communication Problem

California utility uses FM radiotelephone successfully in remote and unfavorable topographical areas for dispatching and emergencies under adverse line-of-sight and atmospheric conditions

TWO-WAY FM RADIO has real value for an electric utility; the California Electric Power Co., Riverside, Calif., has been convinced of this fact in the comparatively short time it has had opportunity to make use of such equipment. Its first use resulted from an operating problem having to do with the war effort. A transmission line, constructed to serve the Basic Magnesium, Inc., plant at Gabbs, Nev., had no auxiliary telephone line. The importance of continuous service seemed to justify a test of radio equipment. The transmission line in question, running between Millers, Nev., and Gabbs, Nev., as shown by the accompanying map, is 64 mi. in length and traverses an unpopulated section of the state. Some 7 or 8 mi. from Gabbs the line passes through a gap in the hills and makes a "dog leg" behind a mountain range. This shielding effect was expected to prevent "point-to-point" radio use, but it was decided to give FM a trial nevertheless, and engineers of the Galvin Mfg. Corp. (Motorola) were called in to work with the power company in establishing a workable radiotelephone system.

MAP of Calipatria-Blythe transmission line where FM is now being installed for dispatching operations

Tests were made between a mobile unit, operating along the power line, and temporary test stations at Millers and Tonopah, Nev. The results obtained by the fixed station in Tonopah were so much better than when located at Millers that the Tonopah location was given preference, in itself a fortunate thing, since Tonopah is the operating center for that portion of the transmission system. Completion of the tests indicated that coverage could be obtained from Tonopah to a mobile unit entering the gap in the hills referred to above, while, when testing from Gabbs, communication could be maintained with the mobile unit to a point such that there was a lap of some 15 mi. in the positions of the mobile unit. The tests were conducted with a 50-watt station transmitter and with a mobile unit having a 30-watt transmitter. The frequency used was 31,460 kc. As a result of the tests, 250-watt stations were installed at Tonopah and Gabbs.

In each case, the antenna, of the coaxial type, was located 1,000 to 1,500 ft. from the receiver end to eliminate any stray noise pickup from the high-voltage equipment and bus at the substation. The transmitter was housed in a radio shack at the foot of the antenna and was remotely controlled from the station. Fifty-watt mobile units were used in the patrol cars. Upon completion of the construction of the fixed stations, it was found that very good communication could be had between those two points in spite of the intervening mountain range.

NORTHERN PORTION of California Electric Power Co.'s system where FM is used for dispatching in the rugged weather and topography of Nevada

Cessation of activity at Gabbs made it possible to dismantle and remove the Gabbs radio station early in 1945. It was reinstalled at Control Station, which is a transmission and dispatching center for the northern end of the transmission system. This location is near Bishop, Calif., which is in Owens Valley between the Sierra and White Mt. ranges. The elevation at Control Station is approximately 4,700 ft. and that at Tonopah, Nev., 6,000 ft. but, between the two points, is a 10,000-ft. mountain range, peaks of which rise to a height of 14,000 ft. This looked like a condition that was not at all suitable for FM radio. However, some preliminary testing indicated some possibility of successful station-to-station transmission and, in any case, communication with mobile units within a wide radius could still be had from each station. Upon completion of the Control Station job, it was found that the results were very

REMOTELY CONTROLLED station KGYF located in a valley at an elevation of 5,000 ft. between the White Mts. and the Sierra Nevadas

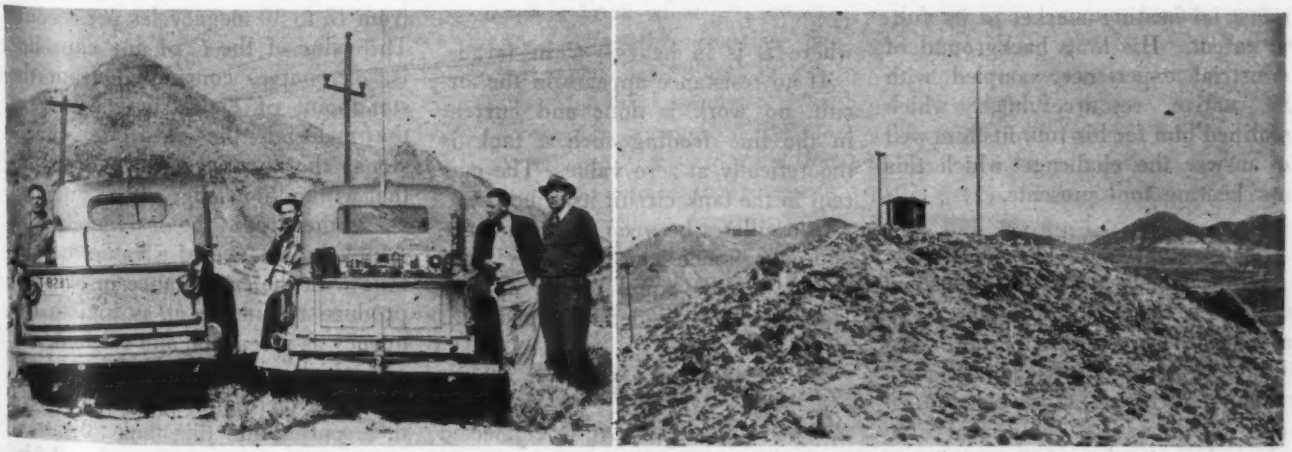
gratifying and that station-to-station communication could be counted upon. Further tests between patrol cars, equipped with mobile units, and the fixed stations indicated certain dead spots, but these were of limited area and of no particular moment, by reason of their location.

In the preliminary field tests, for the most part consisting of a mobile test unit working with a temporary fixed station, the determining factor was the feasibility with which the car could communicate with the fixed station, and vice versa. No quantitative readings were made on a comprehensive basis of signal strength, other than that of speech audibility.

However, our radio supervisor at Control Station reported that, while driving from Tonopah to Control Station, he talked very clearly with Control Station while at Coaldale, Nev., approximately a 4,600-ft. elevation; Control Station being approximately 4,700 ft. in elevation, with an airline distance between them of approximately 60 miles. However, in a direct line between them lies the White Mountain range, and this constitutes a barrier of some 11,000 to 12,000 ft. As to how FM, at 31,460 kilocycles, gets over this mountain range, it cannot be said with assurance; but it can and does get over.

After this success with FM in the northern district, it was decided that FM two-way radio might be the answer to a communication problem having to do with the transmission line running from Calipatria, Calif., to Blythe, Calif., and supplying the entire Palo Verde Valley with electrical energy. This line, 70 mi. in length (see map), traverses an exceptionally bad bit of desert country. General Patton's troops trained over a portion of that desert country, and the sand and extreme heat were severe tests for both vehicles and men. Patrol roads fill with blown sand or are liable to be washed out by cloudburst and, all in all, that particular transmission line is an unusually difficult one to patrol and to repair. Tests made indicated that with a fixed station at either end of the line there is a good chance of maintaining point-to-point communication between stations themselves and, at the same time, of keeping in touch with a patrol car at any point on the line. These installations are now under construction.

Plans call for the installation of several additional stations at other points to completely cover at least that portion of the transmission system in the northern area where severe snow and ice is encountered during each winter. It is thought that the use of a repeater station, located at approximately a 10,000-ft. elevation, will be a decided aid in obtaining complete coverage and eliminating the few dead spots. Some of the points at which it is expected to establish regular FM service are already served by operating telephone lines, and it might be wondered why the additional means of communication is considered necessary. The fact is that severe weather conditions, such as winds of cyclonic violence, 4 to 6 in. of sleet, snow slides, rock slides and cloudbursts all have a habit of taking out the telephone line at the same time they destroy the power line, since the operating telephone line is so often located in the vicinity of the power line. FM radio seems to be one means of communication that is not so apt to be put out of commission by the elements and, for this reason, the power company considers it an important adjunct to a transmission system. All of the FM equipment mentioned is of Motorola-Galvin manufacture.



RADIO-EQUIPPED PATROL CARS (left). Both transmission line and telephone line are shown in this Nevada scene. Telephone line does go out occasionally, hence the need for radiotelephone. (Right) Remotely controlled transmitter of KGYB located on a hill at elevation of 6,500 ft. back of substation near Tonopah, Nev. Part of the famous mining town of Tonopah can be seen to the left of the hill. High winds made it necessary to guy-down roof of the shack

Dielectric Heating in Industry

Rapid development of desirable market for power sales advocated as high-frequency heating applications advance in plastic manufacture—Notable time savings achieved with excellent quality control in processes, particularly heating of preforms

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THE DEVELOPMENT of industrial high frequency heating applications is rapidly capturing the interest of the utility industry. Sufficiently widespread discussion has resulted from previous articles on this subject to suggest that a further treatment, dealing with a more specialized phase, appears desirable. Rapid progress has been made in the field of induction heating of metals (conductors), but there is now opening to the power industry an equally promising market for the post-war sale of industrial power. This is in the field of dielectric heating (of non-conducting materials).

The utility industry has a greater stake in the development of industrial dielectric heating than any other organization connected with it. The power sales engineer, well versed in electric circuit theory and industrial heating practice, needs only to review his fundamentals and to visualize the elementary electronic oscillator concepts in order to develop this new industrial heating market to its fullest extent. His long background of industrial experience, coupled with the native resourcefulness which qualified him for his job, fits him well to answer the challenge which this new heating tool presents.

Basic Oscillatory Facts

While it is desirable that industrial engineers have a thorough background in electronics, it is quite feasible to develop industrial heating applications without a completely rigorous mathematical analysis of what takes place in the oscillator circuit. Rather, a mental picture of high frequency oscillations, their cause and effects, will suffice to open the way to a satisfactory familiarity with dielectric heating equipments.

When an inductance and a capacitance are connected in parallel, a circuit exists which when properly designed can store relatively large amounts of energy. Such a circuit is called a "tank," due to this storage characteristic. The two circuit elements constituting the tank are related to frequency as follows:

$$\text{Inductive Reactance} = X_L = 2\pi fL$$

$$\text{Capacitive Reactance} = X_C = \frac{1}{2\pi fC}$$

It is seen that since X_L varies directly as frequency, and X_C varies inversely, there is some one value of frequency at which these two reactances will equal each other. This equality exists at "resonant" frequency, and it occurs at a frequency such that

$$X_L = X_C$$

$$\text{or } 2\pi fL = \frac{1}{2\pi fC}$$

$$\text{from which } f = \frac{1}{2\pi\sqrt{L \times C}}$$

where L is in henrys, C in farads.

If no resistance appears in the circuit, no work is done and current in the line feeding such a tank is theoretically at zero value. The current in the tank circuit itself however, as it oscillates between the inductance and capacitance, can have very large values, and is equal to the applied (tank) voltage divided by impedance:

$$I\ (\text{tank}) = \frac{E\ (\text{applied})}{\sqrt{X^2_L + X^2_C}}$$

When a resistance R is connected in series with the tank capacitance the circuit is as shown in the diagram (Fig. 1).
and the equation for I is

$$I = \frac{E}{\sqrt{R^2 + (X_L - X_C)^2}}$$

This is the situation existing when the electrodes of an industrial dielectric oscillator are used as "condenser plates" for applying the radio frequency power to the dielectric material which is to be heated. A real resistance is inserted in the capacitance branch of the circuit, which is made up of the actual material to be processed. Its electrical resistance, combined with the current flowing through it, produces heat in the old familiar form of I^2R, in watts. Voltage gradient causes high frequency molecular friction, which is heat.

Resonant Circuit

It is only necessary to oscillate this circuit at a resonance of ultra high frequencies in order to obtain a satisfactory degree of heating speed. Therefore, values of L and C (the C representing the tank capacitance including the load) are selected to produce oscillations at the rate of from 15 to 30 megacycles per second. The value of the C of any capacitor is, of course, considered from the standpoint of dielectric constant of the material, the electrode dimensions, the applied voltage, etc., so that with a knowledge of the intended use of the circuit, the designer installs a tank inductance of a value to combine with the capacitance in order to produce resonance at as high a frequency as is feasible and efficient, and one which can be easily maintained.

A fast acting switch would feed d. c. pulses into this tank to sustain oscillations, if one were available, and if its frequency were controllable. It is obvious however, that an imaginary switch, without any inertia, must

be used, if we are to continue oscillations at the ultra high frequency required; that is, if we are to introduce this d. c. pulse at just the right point in the oscillating wave. Since no ordinary switch has ever been conceived, the electron tube replaces the "switch." It is an extremely high speed "contactor," inserted in the circuit as shown in the diagram (Fig. 2).

The grid voltage is arranged 180 degrees out of phase with the anode voltage and is biased by R_g to give the proper "kick" to the oscillations in the tank, by tube conductance, as illustrated in the graph (Fig. 3):

The necessity for shifting the impulse giving grid voltage 180 degrees out of phase with the radio frequency oscillations (of anode "tank" voltage) is apparent. If in diagram (Fig. 3) the impulse (of the conducting kick of the tube) were to be introduced at any other instant than at point "a", then the anode oscillations would be slowed down instead of aided. Point "a" is therefore the only point at which the tube can fire if it is properly to provide the necessary high frequency energy. This ideal point

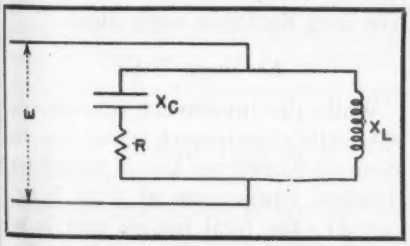


FIG. 1—Electrodes of industrial dielectric oscillator used as condenser plates

is at a maximum (positive) of grid voltage when anode voltage is negative maximum. Therefore it is 180 degrees shifted in phase. The radio frequency choke (r.f.c.) in the anode circuit prevents the high frequency "tank" oscillations from entering the DC anode supply. R_g is a biasing resistor to provide proper grid voltage, making the tube operate as a class "C" amplifier. DC supply for cathode-anode polarity (shown as a battery) comes from a full-wave rectifier.

Commercial High Frequencies

Having established the fundamental elements of oscillation, what frequencies are indicated, in order to provide a satisfactory heating rate for average dielectric heating processes? In induction heating of metals, the author showed (ELECTRICAL WORLD, March 3, 1945, page 72) that maximum power results when such a frequency is selected that the internal

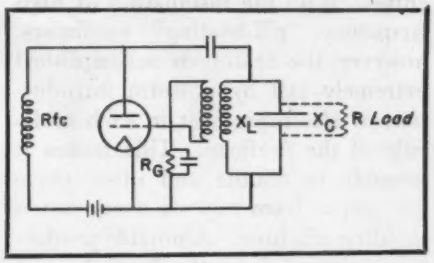


FIG. 2—Electron tube acts as high-speed contactor to feed d.c. pulses into tank to sustain oscillations

power factor of the work to be heated is 70 percent. While as yet no simple calculations for dielectric heating are established we can reach some definite conclusions from the fundamental concept of dielectric (or "capacitance") heat generation:

$$\text{Heat} = \frac{105 \times W \times S \times \text{temp. rise}}{t \times C.E.} \quad (1)$$

where Heat is in kilowatts
W is pounds of material per sec.
S is specific heat of material
Temp. rise is in deg. F.
t is no. of seconds for the heating cycle
$C.E.$ is coupling efficiency expressed as a whole number. (An example would be 90, for coupling efficiency of a plastic heating oscillator using contact electrodes)

Rate of Heat Generation =

$$\frac{K \times C \times E^2 \times P.F.}{t^2} \quad (2)$$

where C is capacity in m.f.
E is applied voltage
$P.F.$ is power factor of the dielectric material
t is thickness in inches
K is a constant

It is seen from equation (1) that coupling efficiency is important; and this depends upon electrode design and shape. Operating practice discloses that electrodes should in general contact the work wherever feasible. While it is recognized that an air gap between the work and the upper electrode cannot dissipate heat losses (dielectric loss factor of air being zero), the applied voltage between electrodes must naturally be greater to produce a given volts-per-inch in the work being heated. Thus the kva. rating of the oscillator must be greater than may otherwise be required if air gap electrodes are used. Many applications require an air gap between the top electrode and the work, however, for uniform heating.

Equation (2) shows us that as high a voltage as is practical should be used, but between electrodes, voltage increase is limited by eventual arc-over and frequency increase is of next importance.

Maximum heating speed is related to frequency by:

$$\text{Time } T = \frac{0.43\ K \times \text{temp. rise} \times S \times D}{f \times C \times P.F.} \quad (3)$$

where T is in seconds
S is specific heat
D is density, pounds per cubic foot
C is dielectric constant
$P.F.$ is power factor of material.
K a factor related to shape of the dielectric (material thickness).

Thus, the higher the frequency in general applications the shorter the

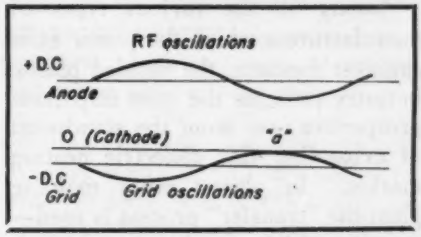


FIG. 3—Radio frequency and grid oscillatory relationship

heating time. The limit to frequency is the available and efficient power output from commercial oscillators, which establishes a frequency of 30 megacycles as about the top for industrial purposes. A simplified form of the above equation is submitted (*Plastics*, June, 1944):

$$H = C \times LF \times f \times V^2 \quad (4)$$

where H = Btu. per sec. per lb. of preform
C = Constant (dependent upon density and spec. heat)
LF = Loss factor expressed as a decimal
f = frequency in megacycles
V = volts per inch across the preform.

From both experimental and practical heating work already performed, supplying known values for the other quantities of equation (4), the value of C for a typical compound of cellulose-filled vinyl acetate, heated at an applied power rate of 1.5 kw. per lb. and a voltage gradient of 2,500 volts per inch, is calculated to be 1,015 Btu. per sec.

Inserting this value of C, and solving for f with varying values of V, the following data have been prepared (June, 1944, *Plastics*):

Relation between Kv. and Megacycle values

Kilovolts per In.	Frequency in Megacycles
23.2	0.5
11.6	1.0
6.2	3.5
4.4	7.0
3.1	14.0
2.2	28.0

Since approximately 3 kv. per inch is about the maximum voltage stress which normal preforms can experience without arc-over, it appears that 14 to 28 megacycles is the approximate useful frequency range. If the Federal Communications Commission settles on its presently contemplated 27.4 m.c. as the industrial dielectric wave-band, then all industrial heating of this type will be at 27.4 m.c. Adequate shielding of electrodes will also be required, which can be accomplished by proper equipment design.

Advantages of H. F. Heating

Among all the various types of manufacturers which the power sales engineer contacts, the molded plastic industry presents the most important prospective user from the standpoint of expanding this dielectric heating market. In almost every molding plant the "transfer" process is used—i.e., the molding powders are rammed, cold, into preformed "pills" for heating and subsequent transfer to the compression molding machines. The time for preheating the pills is far greater than the molding time, and pill preheating is entirely unsatisfactory with convection or radiant ovens because the material is far too difficult to heat from external sources. The pills neither accept heat readily, nor do they conduct it to their centers. Therefore, after transfer to the molding machine, heat from the mold itself must slowly penetrate the pills, and this is definitely uneconomical. The compression molding machine representing several thousands of dollars of invested capital, (including its dies) becomes a make-shift "heating" device instead of solely a molding machine. With the installation of high frequency "pill-heating" oscillators, however, the heating is accomplished extremely fast by uniform introduction of electronic heat in each molecule of the preform. This makes it possible to double and often triple the output from a given compression molding machine. A notable production increase is naturally welcomed by the progressive owner of a molding plant.

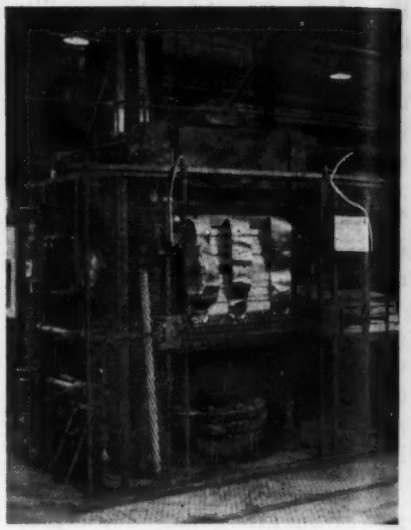
To Meet Competition

The well-nigh miraculous ability of electronic oscillators operating in the 15 to 30 m.c. range uniformly to generate heat within the mass makes the use of dielectric preheating a "must" in every compression molding process, if competition of the molding plants already utilizing this modern equipment is successfully to be met by others. The exception to this broad statement is the plant manufacturing completed products weighing less than ½ lb., where investment in electronic preheaters is sometimes questionable. Extreme plasticity of preforms obtained with dielectric heating in both large and small products offers unique advantages unobtainable by any other means. These are:

(1) Substantial reduction in molding pressure due to this preform plasticity, which reduces maintenance costs and lengthens die life.

(2) Reduction in shearing of pins and inserts due to pressure reduction.

(3) Reduction of cure time to about 25 to 30 percent of the time required with conventional equipment and technique, making the electronic investment extremely attractive from the labor angle alone.



50-KW., R.F. OSCILLATOR operating at 17 m.c. at Trafford, Pa., for fast curing stacks of micaria sheets

Economic Data

While the investment in dielectric pill-heating equipment is not low (it averages $1,000 per kw. of output for standard equipments of 1 to 5 kw. output), the total hourly cost is so attractive per pound of product that molding plants in general are convinced of the substantial economies of preform heating with r.f. energy. Typical hourly costs, for an oscillator of approximately 3 kw. output, follow:

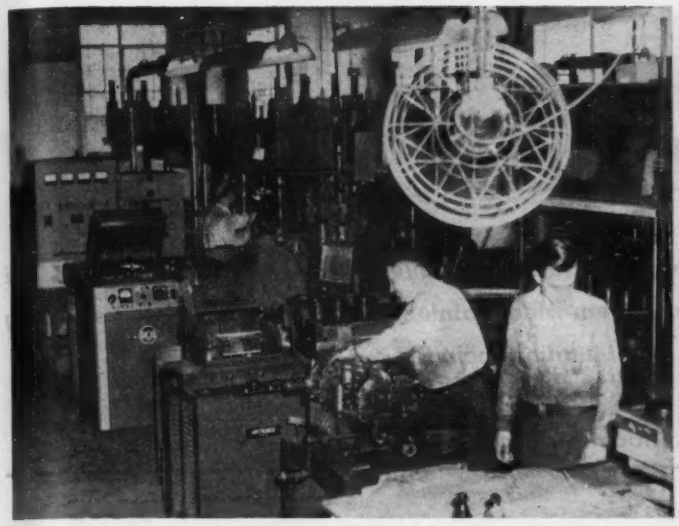
Power Cost—	*cts. per hr.*
5.5 kw. input at 1.5¢ kw.-hr....	8.25
Tube replacement at $300.00 for 4,000 hours average life.....	6.50
Ten year amortization for $3,000 investment based on 3,000 hr./year of use.....	10.00
Total fixed and operating costs	24.75

Obviously, no present day investment opportunity can be ignored which, conservatively stated, will double the hourly production of a man and a machine for less than 25 cents per hour of total cost! A molding plant using 40 presses will install economically a minimum of 20 r. f. oscillators, utilizing approximately 100 kw. of input (60 cycle) power continuously, with an approximate diversity of 60 percent. Power

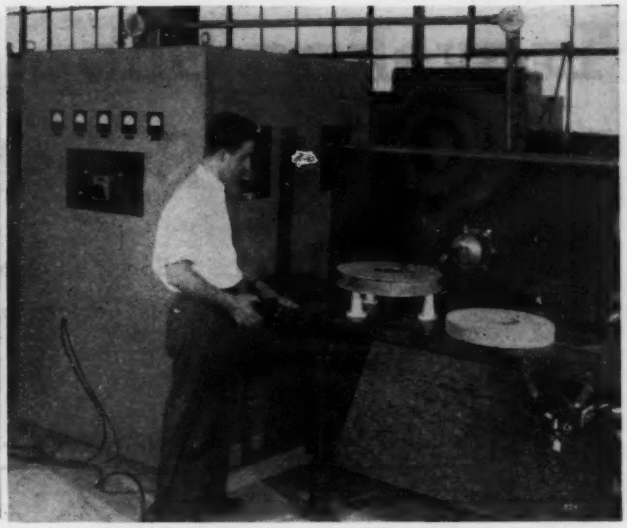
Table 1

Approximate Material Properties of Common Dielectric Substances at 1–30 M. C.

Material	Dielectric Constant	Power Factor %	Loss Factor (Product of P.F. and D.C.
Vinyl Acetate			
Cellulose Filled—Molded	6.0	5.0	0.3
Preform	3.7	4.5	0.17
Powder	1.9	2.7	0.06
Phenolic Resin	6.5	...	....
Wood Flour Filler—Molded	6.5	4.5	.29
Perform	3.8	4.1	.16
Powder	1.8	2.9	.05
Melamine Resin			
Mica Filler—Molded	6.0	4.0	.24
Preform	...	...	....
Powder	1.7	1.75	.029
Phenolic Resin			
Cotton Filler—Molded	5.0	5.0	.25
Preform	3.7	4.1	.15
Powder	1.8	3.0	.05
Rayon (dry)	2.1	8.5	.18
Transite	6.0	12.0	.72
Tenite	3.1	3.0	.093
Micalex	6.2	0.17	....
Plate Glass	5.5–9	0.2–0.4	....
Porcelain	5.5	0.8	....
Hard Rubber	2.8–3.3	0.3–0.8	....



WATERBURY COMPANIES, Waterbury, Conn., more than doubled former production when these radio frequency oscillators were installed for preheating plastic preforms



20-KW. OUTPUT DIELECTRIC HEATER used to cure the binder in alundum abrasive wheels at 10 m.c. Increased speed, uniformity and higher economy have resulted

factor of this load on the input side is close to 95 percent, and equipments can be three-phase or single phase as required. Moreover, the preliminary engineering in this important field has been completed and the market is ripe for cultivation.

Since electrical properties of various materials are of such obvious importance, Table 1, showing these properties is presented in order that commonly used dielectric materials may be visualized as regards their desirability for radio-frequency heating.

Typical of important work which radio-frequency oscillators are economically performing is the fabrication of sheet Micarta. The 50-kw. r. f. generator operating at 17 megacycles is illustrated, wherein radio frequency energy is used to cure standard sheets, under pressure. The sheets are stacked between electrodes. The center electrode is the "hot" terminal of the oscillator; the two external electrodes being connected to ground. Bonding straps, connecting the grounded electrodes together, are shown. The sheets are stacked 2½ ft. high, occupying 3 ft. by 5 ft. of horizontal electrode space. Press faces are lined with copper sheets for furnishing proper contact to the oscillator. Insulating problems are eliminated, of course, when the external electrodes are connected to the grounded terminal of the oscillator. The installation is in daily use at the Trafford (Pa.) Micarta Works of the Westinghouse company. Excellent speed, and overall economy are realized with this modern dielectric heating equipment.

Table 2

Physical Effects of Electronic vs. Standard Molding on Flow Characteristics of Molding Materials

Type of Phenolic Molding Material	Method of Molding	Total Pressure	Time of Mold Closing
General Purpose.....	Standard	17,000	25 sec.
	Electronic pre-heating	17,000	6 sec.
	Standard	8,000	Not filled
	Electronic pre-heating	8,000	6 sec.
Impact-Resistant.....	Standard	14,000	35 sec.
	Electronic pre-heating	14,000	4 sec.
High Impact Resistant.	Standard	30,000	32 sec.
	Electronic pre-heating	30,000	11 sec.
High Heat Resistant...	Standard	16,000	25 sec.
	Electronic pre-heating	16,000	13 sec.

Abrasive wheels typify another interesting application. A phenol formaldehyde binder must be uniformly cured in this process, and radio frequency energy again performs its function economically, uniformly, and fast. Alundum (Al_2O_3) bonded with phenol formaldehyde, heated, under test, with 10 m.c. of r. f. energy, is illustrated, using 20 kw. of output power. This trial has already led to a pilot industrial installation. The picture shows the 20-kw. oscillator and overhead transmission line carrying power to the impedance-matching cubicle. The wheels are preheated between the disk-electrodes, and immediately transferred to the molding press for complete curing under pressure.

So many opportunities exist in so many industries for the sound and economic application of dielectric heating that power engineers of utilities are going to find themselves extremely busy now that VJ Day has come, and equipment becomes obtainable. In view of the rapid progress which is now going on, it is not too much to predict that one or more high frequency specialists will be required in each industrial area, in order to develop this highly promising market to its fullest extent for the benefit of post-war industrial power sales.

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Dnieper Hydro Is Being Rebuilt

Some of the 26 wrecked piers of the 558,000-kw. Dnieper plant have already been replaced as the first step in restoring the capacity. As a whole the job constitutes one of the most difficult reconstruction tasks in the entire war area. Up to March, 1945, (the latest news available here) some 300,000 tons of concrete had been blasted out and hauled off. Experience has indicated that it is easier to destroy and remove damaged concrete than to try to repair and restore it.

When the Red Army units retired in August, 1941, they blew up the upper part of the dam. They did not wreck the generating station, merely trying to render it useless to the Germans by dropping the head drastically. When the Germans retreated in 1943, they completely wrecked the station's structure.

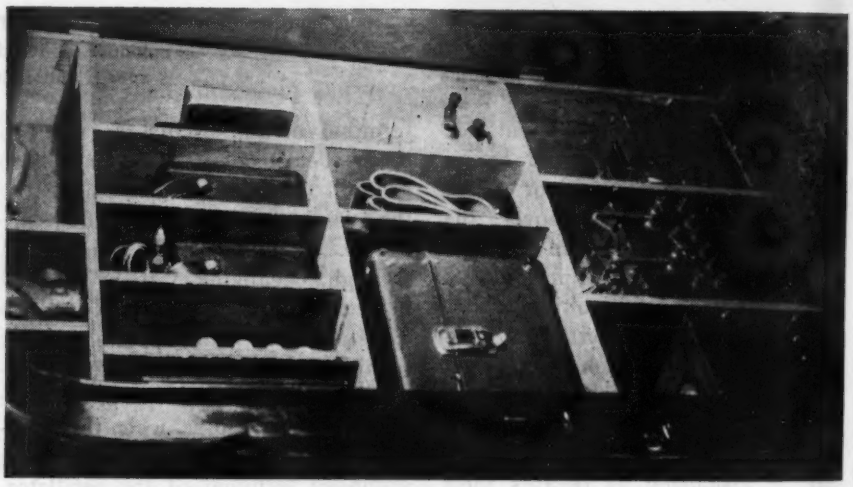
Traveling Shop Maintains Substations

Special maintenance truck and trailer fitted out with instruments and test devices for system-wide maintenance of substations and switching facilities—Oil rehabilitation included

J. B. HENDRICKS, Wisconsin Gas & Electric Co., Racine, Wisconsin

SUBSTATION and switching equipment maintenance on the Wisconsin Gas & Electric Co. system is done by a single "circuit riding" maintenance foreman traveling over a 6,000-sq. mi. area and covering some 60 odd stations once every 15 months. He carries all tools, equipment and instruments necessary for any test or maintenance operation with him at all times in a panel truck and trailer. He draws help from the divisions when required.

Before this system was adopted each of the four divisions was responsible for maintenance of its substations. A certain duplication of equipment and personnel, as well as variation in maintenance procedure among divisions, resulted. While these are not serious drawbacks a centralized maintenance operation offered several distinct advantages on a rural system such as this serving 75,000 customers a large number of which are farms in southeastern Wisconsin.



INSTRUMENTS FOR SUBSTATION MAINTENANCE are carried in locked compartment of panel truck beside the driver's seat

OIL TEST AND MAINTENANCE TRAILER contains all equipment necessary for filtering oil in substation apparatus. Trailer is 14 ft. by 7½ ft. by 8 ft. overall

Besides placing responsibility for proper substation maintenance in one individual, centralized responsibility insures that benefits of experience in one division will be available to all through a specialist whose duties do not extend beyond this type of work. Duplication of equipment is avoided. Moreover, all substation maintenance equipment necessary for any job is put in the field at one time, where needed and under the responsibility of a single individual; it is not scattered about the system.

Not the least interesting phase of this maintenance operation is the range and disposition of tools, equipment and instruments carried by the foreman in the truck and trailer from which he works. The trailer, in general, contains only oil test and maintenance equipment while the truck carries tools and instruments.

The substation maintenance truck is a standard one-ton panel truck fitted with compartments for rubber

SUBSTATION TEST AND MAINTENANCE WORK is done by one man from a truck equipped with all necessary tools and instruments

goods, switch sticks and hot line tools, instruments and the usual complement of hand tools. A locked cabinet adjacent to the driver's seat contains most of the truck's complement of instruments, including:

1. Megger—2,500 v.
2. Capacity bridge—for bushing power factor tests
3. Cycle counter
4. Phantom load
5. Phase angle meter
6. Load box
7. Ammeters; voltmeters and wattmeters—both a.c. and d.c.
8. Recording thermal-type demand meters—six connected to read power and reactive on three phases
9. High current testing transformer
10. Rotating meter standard
11. Potentiometer
12. Live-line insulator tester—voltage drop type.

Trailer and Equipment

Rather than carry oil maintenance equipment on the testing truck where it would impose a "housekeeping" problem in addition to occupying valuable space when not needed, it has been relegated to a special two-wheel oil maintenance trailer measuring 14 by 7½ by 8 ft. overall and which weighs 2,210 lb. fully loaded. Equipment carried includes:

1. Oil filter press—7 by 7 in. blotter size
2. Blotter storage—two cases of blotters
3. Blotter dryer
4. Oil breakdown tester
5. Motor driven oil pump—with by-pass piping
6. 125-ft. 3-conductor electric cable on reel
7. Armored oil hose.

Piping between the oil pump and filter press, as well as by-pass piping to permit the pump to operate without the press, is built into the trailer as are all the major items of equipment. Convenience of arrangement of this trailer is evident from the fact that it can be set up and filtering oil within ten minutes of its arrival on location. Side panels of the trailer body (Barkow) are hinged horizontally at the top to raise and provide shelter from storms. Doors at the front and rear of the trailer also open giving complete access to all parts.

With the equipment provided on the truck and trailer it is possible for the substation maintenance foreman to swing rapidly through the sequence of testing station relays, filtering breaker oil, inspect the breaker, test its bushings and operating mechanism, verify its lockout and timing, remove the station from service, megger the transformer, test transformer, bushings and oil all without having to leave the station for special test or maintenance equipment elsewhere on the system. This efficiency and accessibility of tools is one of the major features of the maintenance set-up which has been in use on the system since 1940.

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Rat Initiates Chain of Mishaps

Rising flood waters of the Ohio this spring caused all the river rats to seek the security of higher levels. One in particular seemed more panicky than the rest; he climbed to the roof of the Ohio Falls Station, hydro plant of Louisville Gas & Electric Co. Even there "Snoopy" was not confident of security so he jumped to a small ledge of concrete and thence to the body of an adjacent pothead of the cable to the 450-kva. station transformer. That was the finish of the rat but merely the beginning of a sequence of untoward events.

The breaker on the circuit supplying the bank from the 14-kv. main bus tripped out and the station attendant, oblivious of Brother Rat's inquisitiveness, reclosed the breaker. For reasons still to be established, the breaker pumped and reclosed on the fault twice—sustaining the fault some five seconds.

Arc at the pothead travelled to the 450-kva. transformer bank and left the bushing metal-parts in the nude after stripping the petticoats from the bushing insulator.

About this time two 15-kv. current transformers decided to explode; man-sized holes were burned in their enclosure. V.C. cables in the C.T. box and the adjoining 14-kv., disconnect-switch compartment were damaged.

Evolution of Aerial Cable Distribution—II*

Performance compares favorably with underground cable—Two lightning failures per 100 miles per year—Faults readily located and repaired by splicers after temporary repairs by linemen—Solves tree troubles—No radio interference experienced

GEORGE H. LANDIS,** Central Hudson Gas & Electric Corp., Poughkeepsie, New York

MOST OF THE NO. 4 aerial cable on the Central Hudson system is installed on single-phase lines and most of the larger size cables are installed on three phase lines. Approximately 95 percent of this cable (Table I) is insulated with oil base compound, the other 5 percent being insulated with varnished cambric. To date, the largest size cable installed is No. 4/0, but there is no reason to believe larger cables could not be used.

Except for failures from lightning, the performance shown in Table II compares very favorably with underground cable. Improvement in performance may be expected with improved manufacturing processes in the later cables, and improved technique in the care and handling of cable during installation. Lightning exposure on many of these cables is severe, as much of the cable is installed in rural areas, frequently in fairly short lengths of two to five spans, and tied into open wire lines on each end. Present practice calls for distribution type arresters to be installed at all terminal poles where cable is connected to open wire lines. The arrester ground lead is bonded to the common neutral messenger and also connected to ground rods driven at each terminal pole. No attempt has been made to measure ground resistance, but some improvement may be made in this respect as a program for ground measurements of all installations progresses.

A large proportion of the cable in service is installed in locations of heavy tree growth. Here its performance is outstanding, as shown by the record. Ordinary limbs have no effect on its performance, and the only cases of failure recorded have been where large trees have broken the messenger. In several instances the cable line has continued to function without interruption when poles have been broken off and the lines have fallen to the ground. No interruptions were caused by cable failure during the hurricanes of 1938 or 1944, nor by several severe sleet storms, which caused interruptions to large parts of the open wire distribution system.

Where cable failures have occurred, no great difficulty has been experienced in finding the fault. The cable damage, though not extensive, has been readily found by patrolling. In no case has it been necessary to resort to Kenotron testing to locate

Table I

Feet of Aerial Cable Installed

Year	1/c #6	1/c #4	1/c #2	1/c #0	1/c #2/0	1/c #4/0		Total Conductor Feet
1931	.....	7,200	.....	.....	.....	.....	.....	7,200
1932	.....	.....	.....	.....	.....	.....	.....	.....
1933	.....	.....	.....	.....	.....	.....	.....	.....
1934	.....	1,400	14,170	.....	.....	.....	.....	15,570
1935	.....	5,428	21,695	30,000	.....	.....	.....	57,123
1936	.....	36,485	9,065	6,290	.....	.....	.....	51,840
1937	.....	6,000	.....	33,150	26,560	.....	.....	65,710
1938	.....	82,100	5,900	.....	.....	.....	.....	88,000
1939	.....	68,854	62,980	14,000	15,600	.....	.....	161,434
1940	19,126	41,927	36,350	20,265	.....	8,274	.....	125,942
1941	.....	50,020	9,940	5,000	.....	.....	.....	64,960
1942	.....	.....	.....	.....	.....	.....	.....	.....
1943	.....	.....	.....	.....	.....	.....	.....	.....
1944	.....	.....	.....	.....	.....	.....	.....	.....
Total 1/c cable	19,126	299,414	160,100	108,705	42,160	8,274	.....	637,779
			3/c #2	3/c #0		3/c #4/0	Total Feet 3/c Cable	Total Conductor Feet
1940	.....	.....	13,440	5,000	.....	.....	18,440	55,320
1941	.....	.....	24,170	47,405	.....	1,540	73,115	219,345
1942	.....	.....	.....	.....	.....	.....	.....	.....
1943	.....	.....	.....	.....	.....	.....	.....	.....
1944	.....	.....	.....	.....	.....	.....	.....	.....
Total 3/c Cable	.....	.....	37,610	52,405	.....	1,540	91,555	.....
Total Conductor Feet of 3/c Cable	.....	.....	112,830	157,215	.....	4,620	.....	274,665
Total Conductor Feet All Cable	19,126	299,414	272,930	265,920	42,160	12,894	.....	912,444

* First installment appeared in ELECTRICAL WORLD, August 18, 1945, page 84.
** Electric Distribution Manager.

Table II

Aerial Cable Performance

4,160-Volt, 3-Phase 4-Wire, and 4,800-Volt Delta Systems

Year	Splice Failure	Insulation Breakdown	Lightning	Rifle Shot	Falling Trees	Road Construction	Misc.	Total by Years	Annual Cable Installed Feet	Cumulative Feet Cable Inst.	Cumulative Miles Cable Inst.	Failures per M. Year
1931	.....	1	.....	.....	.....	.....	.....	1	7,200	7,200	1.4	.715
1932	.....	.....	.....	1	1	.....	.....	2	.....	7,200	1.4	1.430
1933	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,200	1.4	.....
1934	.....	.....	.....	1	.....	.....	.....	1	15,570	22,770	4.2	.238
1935	.....	3	.....	.....	.....	.....	.....	3	57,123	79,893	15.1	.198
1936	1	2	.....	.....	.....	1	1	5	51,840	131,733	25.0	.200
1937	.....	.....	1	.....	.....	.....	.....	1	65,710	197,443	37.4	.025
1938	1	6	3	.....	1	1	.....	12	88,000	285,443	54.0	.222
1939	1	10	2	.....	.....	.....	.....	13	161,434	446,877	84.5	.155
1940	.....	1	1	.....	.....	.....	.....	2	181,262	628,139	118.8	.017
1941	1	3	1	1	.....	.....	.....	6	284,305	912,444	172.5	.035
1942	4	4	2	.....	.....	.....	1	11	.....	.....	172.5	.063
1943	.....	1	8	2	.....	.....	.....	11	.....	.....	172.5	.063
1944	1	1	2	.....	1	.....	1	6	.....	.....	172.5	.035
Total by Cause	9	32	20	5	3	2	3	74	.....	912,444	1,033.2	.0725
Average per Mi. Yr.	.010	.030	.02	.005	.003	.002	.003	.0715	.....	.....	.....	.....

The above performance table is based on single conductors, as interruption records do not readily permit segregation into faults on single phase and three phase installations.

Approximately 65% of above conductors are installed on three phase lines, and 25% on single phase.

Single phase lines consist primarily of one insulated conductor and messenger neutral.

Messenger neutral is not included in above table for either single or three phase installations.

Original experimental cables are not included in above tabulation, since the performance of these cables is not indicative of the performance that may be expected of cable of later design.

Cable of one manufacture, all of which was removed due to defective insulation compounds, has also been eliminated for same reason.

faults. No cases of messenger burn down have been experienced to date, although it is readily conceivable that this may occur where short circuits are heavy and breakers are reclosed, as we have had this happen on aerial transmission cables suspended from messengers where the breakers have been repeatedly reclosed on faults.

Repair of Faults

Length of time required to repair a cable after a fault as compared to open wire lines is difficult to measure with any degree of accuracy, as much of the interruption time is dependent on travel time and the working facilities immediately available for the particular job. Temporary repairs may be rapidly made on cables by ordinary linemen, as it is only necessary to cut back the shielding tape and a little compound at the fault location and fill the gap with rubber tape. Obviously such repairs are made only with the circuit de-energized, as faults are not indicated until failure occurs. Under unusually favorable conditions, cables have been restored to service in less than ten minutes from the time of failure.

No radio interference has been experienced with this type of cable, except where the cable was of defective manufacture. In these instances, radio reception was practically blotted out, and gave immediate notice that trouble could be expected.

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Rolling Mill Swings Controlled

Automatic load control was recently installed on two 20,000-kw. turbo-generators at the Fairfield power plant of the Tennessee Coal, Iron and Railroad Co. (U. S. Steel Corp. subsidiary) to reduce the magnitude of the load swings imposed on an Alabama Power Co. tie line when the continuous hot strip mill is operated. An amplidyne operates the pilot motor of a hydraulic relay to control the steam admission valves. Comprehensive report is found in a symposium of five papers prepared by engineers of the steel company, the utility and the General Electric Co. for the canceled Detroit meeting of the A.I.E.E.

Power drawn by a large strip mill may build up to 25,000 kw. in 10 sec., stay nearly constant for 60 to 75 sec. and then fall off nearly to zero in another 10 sec. About a minute and a half intervenes while the ensuing slab is oriented. Such a 25,000-kw. swing would vary the frequency some 0.0156 cycle over the 16,000,000-kw. system with which Alabama Power is interconnected; variations in the local tie-lines however are very pronounced particularly if the swing is more rapid than the response-time of the tie-line regulator. Since it takes 9.2 sec. for the regulating plant to start responding to a tie-line load deviation the regulator on the tie to Tennessee Valley Authority system has been completely ineffective.

The solution was to absorb all or part of the hot strip mill load swings at their source by causing the generating plant at the steel mill to increase and decrease its output in synchronism with the strip mill load swing cycle. By utilizing both steam-line storage and flash-evaporation the boilers can supply up to 16,160 lb. of steam per minute while pressure drops from 335 to 315. Carryover is the limiting factor.

The load controller holds the desired base load on the unit and compares the measured consumption of the strip mill with the excess of the generator output over base load. If any difference in these values occurs the load controller operates the turbine valves through a servomotor to rebalance the equation.

Two seconds is required for response of the controlled generator. If steam-plant boiler conditions at Fairfield would permit operations with a 100 percent pick-up setting the hot strip mill load swings would be completely eliminated from the C&S-TVA ties, it is concluded,

Editorials

S. B. WILLIAMS, *Editor*

Food Refrigeration as a Load Builder

WITHIN THE NEXT FEW YEARS tremendous expansion in the production and consumption of frozen foods is certain. Estimates of sales of home food freezers in the next three years run as high as 2,800,000. The present number of locker plants—more than 6,000—will be multiplied many times. Commercial processors will extend their operations in volume and in inclusion of food items as fast as public acceptance of their products and availability of processing equipment will allow. These developments, no longer "post-war" projections, but imminent actualities, add up to significant loads for electric utility systems. These loads will not only be of respectable size in total; they will also be desirable because of their inherent diversity characteristics.

But this is by no means the complete picture of refrigeration—which is electricity system load—in the coming changes in food processing and distribution. There is another aspect that popular interest in the future of frozen foods has caused to be generally overlooked. This is the distribution of fresh fruits and vegetables which, reacting from the competition of frozen foods, is bound to be greatly improved. The way of that improvement is refrigeration from garden to retail buyer.

The fresh produce market now takes twenty times as much fruit and vegetables as does the frozen pack. That ratio will decrease to some value of competitive equilibrium which no one can predict but which anyone can see will still be high. On equal terms of price and quality, most people will prefer fresh to processed foods.

Refrigeration is no novelty in produce distribution; for years it has been used in long haul transportation of certain items. But it can and, under competitive pressure, undoubtedly will be used for more and more items for more and more of their travel from producer to consumer. Its ultimate application, not too far in the future, according to Clarence Birdseye of quick-freezing fame, is in the retail store where wilted lettuce, dejected carrots and snap beans that won't snap will have been replaced by displays of fruits and garden sass kept crisp and tempting at optimum low temperatures. The power company salesman who knows his groceries will go after that load.

Rates for Tomorrow's Load

NOW IS THE TIME, when preparing to rebuild commercial activities, to go over the rate schedules with a fine tooth comb. Is there anything there that has been troublesome in relations with customers? Is there any fine print that is hard to read or is put in there to protect the company? Is the demand period right? Are the rates truly promotional?

It may easily be possible to justify every part of the rate schedule from the standpoint of cost, fairness to all, readiness to serve, return, but there still may be undesirable clauses. What if they are technically correct? If the customer doesn't like them they aren't right.

The utility industry has a fine record of constantly lowering the price of its service but still its members persist in schedules which are too complicated and difficult to understand either as to application or principle. These aren't arbitrary rates. They were carefully made and for the most part stemmed from a desire to minimize discrimination. That is a laudable objective but if the customer thinks the very opposite is the result then something ought to be done about it.

Nor is reduction of customer annoyance the only reason for going over the schedule with a fine tooth comb. What are the plans of the sales department? What loads could be promoted quickly if there was a better rate? In other words, this is the time when coordinated thinking might produce fine results later. This doesn't mean pricing business so low as to make it unattractive to the utility. There have been some rates of this nature made for certain wholesale services which unfortunately have been used to extort similar uneconomic rates in other areas. What we are talking about are compensatory rates that at the same time are load-creative in their application.

Such a schedule, for instance, is the all-electric rate described in a recent issue of ELECTRICAL WORLD. That rate has a definite sales objective and the results so far give every reason to believe that the objective will be reached in not too long a time after residential equipment is again available.

Perhaps there are other package types of rates that can be developed.

At any event, if not already done, now seems to be a good time to restudy the schedules in the light of post-war marketing of electricity.

Up Go Alloy Temperatures

WHILE THE WAR DEPARTMENT withholds composition formulas and performance data, the news is now out, authoritatively, that metals have been devised to function for 9,000 hours at 1,500 deg. F. and 15,000 psi. Again has urgency of military needs pushed outward the frontiers of knowledge at a speed-up rate. Before the war the limit in steam turbines was around 950 deg. F. and hopeful engineers were thinking and talking, albeit cautiously, of a coming day of 1,200 or 1,250 deg. F.

Demand for metals to withstand (among other undisclosed operations) the scorching erosion of jet propulsion blasts in the latest military planes led to intensified research. Result of that research has now added some 550 deg. to the former range, nearly doubling the 300-deg. increment that was fondly envisioned.

In the power field that new temperature opens a door but not full-wide because 9,000 hours amounts to only a little over a year and that is much too short a life for a prime mover that has to earn its keep in utility service. What is needed is 10 times that life and that may not be too far away. Already assertions have been made that 100,000 hours is not too much to predict for a gas turbine working at 1,250 deg. F.

Startling as is the great stride in upping the temperature from 950 deg. F. to 1,500 deg. F., the power industry has no occasion to be either disturbed or exultant about it. Even with 1,500-deg. F. metals reputedly available the gas turbine has several years of development facing it before it will have the endurance, reliability and governing characteristics good enough to supplant the steam turbine. By that time the urge to rely on pulverized coal may be even more compelling than now and further delay the perfection of the gas turbine as a practicable tool for the power industry.

Losses Are Leaks

COPPER WILL PROBABLY always have resistance and core iron will present alternating excitation losses. Consequently no apparatus and no line will ever be 100 percent efficient even though big power transformers do, of course, have remarkably low losses. But the inescapability of loss in energy and absorption of voltage is no reason for being complacent about them. It was not preordained that average loss for the nation's system's should be 17 percent.

War experience has undoubtedly incurred some inordinately heavy losses because it was often not possible to acquire the equipment or facilities which would have averted such losses. On the other hand there were other instances where, say, a line was authorized because without it the losses would have been great enough to have necessitated an additional generator.

When the country emerges from war production one of the fields of study should without question be an evaluation of system losses and of the economic merit of expenditures made to reduce them. There probably has been too much disposition to charge losses at the cost of generation and too little willingness to rate them as saleable at a much higher price if they could be conserved.

There are dozens of other industries that would look upon a 17 percent overall loss as terrific. Anything like a very few percent of shrinkage would start hunts for leaks and inefficiencies. A similarly critical analysis would show that electrical system losses could be averted by justifiable expenditures in some cases and merely by more careful operation in others. One big system now examines every setup for interconnection so that stations will be chosen for loading and power routed over circuits chosen to give minimum loss compatible with the other ruling factors.

It will probably startle some managements to learn that a simple distribution transformer can, in 5 or 10 years of service, eat up losses equal in value to the initial outlay for the transformer. It will probably startle some engineers to suggest that, inasmuch as losses are worth more the farther they are incurred from the source, there might be some sense in having step-down transformers at the receiving ends of long lines with appreciably higher efficiency than those at the step-up end. Anyhow, a critical attitude on system losses might elicit facts no less startling and plenty profitable, if applied.

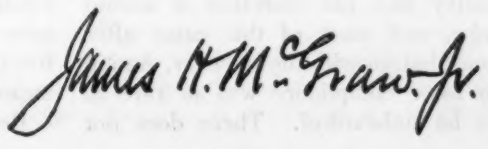
Lee Hill Joins Electrical World

IT IS WITH much pleasure that I announce the appointment of Lee H. Hill as publisher of ELECTRICAL WORLD and *Electrical Contracting* to succeed William K. Beard, Jr., who has been advanced to the post of vice-president in charge of advertising activities for the McGraw-Hill Publishing Co.

Lee Hill brings to these papers an unusually diverse experience in the electrical industries. Educated as an electrical engineer, well grounded in the technical phases of the industry with Westinghouse and American Brown-Boveri, his 14 years with Allis-Chalmers have rounded out his understanding of the whole broad electrical field—engineering, design, development and sales. He has also contributed to its technical progress through his writings on a variety of subjects.

As we get deeper into a period when industrial relations must claim a mounting share of attention from engineers and industrialists, Mr. Hill takes over his publishing responsibilities well equipped on that score. Four years ago he was elected by Allis-Chalmers vice-president in charge of industrial relations. In that capacity he has developed for his company a forward-looking program of employee compensation and training, safety, medical and other employee services. During the war he served as an industry member of the National War Labor Board.

Lee Hill is no stranger to McGraw-Hill, for he is co-author of its recently published book "Management at the Bargaining Table." I am confident that in his new capacity he will bring to the electrical industries the kind of responsible and forward-looking leadership that has been the consistent purpose of these publications throughout their long years of service to them.



WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

A Happy Good-Bye

"WE SAY GOODBYE, now, to the times that we have known."

So wrote the late Raymond Clapper after the enactment of the Lend-Lease program more than four years ago. The message which followed this valedictory told the end of an era in which the United States sat passively by while its friends and its enemies struggled.

Clapper's epitaph for an era seems descriptive of that era in the electric power industry which closes at the end of this month with the removal of all but one war-time control —inventories—and with the disbanding of the Office of War Utilities.

The era opened with the designation of the electric power industry as one of the real weak spots—an Achilles heel—of the American defense-war program. It was called an industry which would be unable, through want of plant, to meet the inevitable demands on it, demands which, unsatisfied, would prevent fulfillment of virtually every other phase of the defense-war program.

Controls Were Strict

Throughout this era, electric power was regulated—of necessity—far more stringently than it ever had been by state or federal agencies. It was refused permission to build those facilities it felt were needed to do the job. It was required to build this facility rather than that. Individual identity was submerged in regional identity. Operating practice was dictated not by what was best for a given unit of the industry but by what was required to do the job.

There was dictation from Washington in all this, but remarkably little. For the most part, OWU and its predecessor agencies dictated only policy and the direction it should take, and most of this came after consultation with the industry. Action to force compliance was so rare as to be unheard-of. There does not come to mind a single case of refusal to interconnect or of particularly vigorous obstruction of any interconnection, even though perfect agreement was often lacking.

Reason for Fear

Perhaps the same can be said of every other industry which underwent wartime regulation by the federal government. Even if true, this would not diminish the value of the cooperation which was extended, and few if any industries had as much reason to fear, in 1941, the results of an encroachment on its position by the federal government. On the basis of its 1933-1940 relations with the government, the electric power industry might reasonably have headed for a storm cellar when war-time regulation was instituted.

As it moved steadily to an early termination of this era, OWU did what it could to repair the casualties which it had, inescapably, inflicted. It authorized, last spring, 2,000,000 kw. of new capacity and substantial other construction. In so doing, OWU gave the power industry a deserved headstart on other industry changing from war to peace. This was no "gift." It was an attempt to alleviate unavoidable hardships. It was also a recognition that if the industry were to be in the best possible position to power reconversion, account must be taken of the "lead time" between placing of equipment orders and operation of that equipment. It was the fulfillment of a responsibility assumed when OWU undertook to superimpose its judgment on that of the industry. In providing that headstart and in adhering to the principle of junking controls as quickly as possible, OWU repaid the response which the industry gave its vexatious program. Neither party owes the other anything but respect for the competent performance of a mean job.

Recalling the atmosphere which prevailed at the start of the era, it seems impossible that the industry should emerge from a period of such complete federal control in as undamaged a position as it now occupies, for, basically, little change in the public-private ownership picture was wrought by WPB since the end of 1941.

Public ownership between December 31, 1941, and December 31, 1944, rose 4.1 percent to 20 percent of the U. S. total, and hydro capacity 1.2 percent to 29.1 percent of the total, the latter caused in part by fuel scarcities. Capacity was approved for Grand Coulee at a faster rate, perhaps, than the Interior Department would have installed it under normal conditions, but it was authorized and would have been crowded in as fast as the public-power Congresses of recent years could have been persuaded to advance the funds. The same is true of TVA. What is significant is that there were no new TVA's or Bonneville Power Administration's established to solve the war-power problem. This was a possibility that would have been far more likely had the priorities power been in the hands of certain more enthusiastic proponents of public ownership.

A Proud Record

Having finished one era with its flags flying, the industry would seem to be in good shape at the opening of another. Its record of war performance—enough power to meet every demand at costs equal to or lower than peace-time charges—can only redound to its credit, even though it has been far less publicized than that of the railroads, the telephone and petroleum industries, which had shortages, rationing and price increases.

This record seems to have been noticed, mildly at least, in Congress, which has been the source of most of the actions inimical to the industry, making it appear that the ground there is more ready for plowing than it has been for a dozen years.

By its organization of the National Association of Electric Companies, the industry has indicated its belief in the story it has to tell and the need for its being told. Properly done, it could make real the feeling that the power business has completed the detour and is back on the paved highway at last.

NEWS OF THE WEEK

OWU's War Power Policy Will Have Lasting Effect

Technological Developments in Power Field Which Have Proved of Value Will Be Retained—FPC Rules Will Determine Continuance of Interconnections—Drop in Kilowatt-Hours Per Kilowatt Expected

"Late in the defense program, the Power Branch adopted a policy of authorizing installation of just enough generating capacity to get by, and that's about what we did," an Office of War Utilities spokesman asserted this week as he reviewed the agency's war power policy and the broad conclusions which may be drawn as a result of its four years of operation.

The principal technological developments of the electric power art which were thrust into prominence and used to great benefit during the war were the interconnection and coordination of neighboring power systems, the use of automatic load control devices and the carrier current relaying of lines, and the extensive use of static capacitors to increase effective capacity of lines and transformers.

Little of great consequence was developed in the technology of steam or hydro generation, and the vast amount of hydro capacity installed developed nothing of a technological nature which would be expected to broaden the use of hydroelectric generation in postwar years.

Kilowatt-hour per kilowatt output rose to new heights during the war under the impact of "around-the-clock" operations in war plants, particularly those making aluminum and powder, but it has been dropping since last year and will continue to drop, even though it may never recede to pre-war levels.

"Except in a few places," the spokesman declared, "we had no surplus capacity margin to speak of. In 1942 and 1943, we got by mainly by interconnection and by not taking machines off the line for normal overhaul. In 1944 and thus far this year, these machines have had to be removed for maintenance, and rehabilitation. Thus, while this year and last we have had proportionately more nameplate capacity than was available in 1942 and 1943, the capacity actually has not been available because of the number of machines down for maintenance."

OWU's predecessor organizations of the early war period planned some large blocks of capacity for emergency loads, installing most of it in the TVA area or in the Northwest. The Manhattan District—the atomic bomb project—used much of the spare capacity available in the Southeast and some of that in the Northwest. In the latter location, however, all the spare capacity installed was not required.

It was the opinion of the spokesman that most of the interconnections ordered during the war period would be retained except those which might be dismantled to allow one or more participants to avoid the ownership of facilities used for the transmission of energy in interstate commerce and consequent liability to jurisdiction of the Federal Power Commission. How many such interconnections are in existence is unknown.

Through the war, FPC has granted exemptions good for the duration plus 3 to 6 months to companies, not otherwise under FPC jurisdiction, which made connections that normally would put them under such jurisdiction. It was predicted that many of the interconnections so exempted would be retained under a clause allowing the existence of interconnections involving ownership of interstate facilities for emergency use only without the owners of the facilities involved becoming subject to FPC jurisdiction. Numerous interconnections between privately owned systems and municipal systems or industrial generating plants have been made, most of which should survive the war, the spokesman predicted.

It was conceded that where an interconnection be maintained for emergency use only, a great deal of its benefits would be passed up; but it was pointed out that such ties would provide prompt relief in an emergency. Many companies which were under FPC jurisdiction before war interconnections were made are much more extensively interconnected now, and such additional ties are expected to be kept in full operation.

Automatic Control Economical

Exigencies of the war period probably caused a broader and faster adoption of automatic load control devices and carrier current line relaying than would have been the case had the nation been at peace during the last four years, the OWU spokesman asserted. Use of these devices grew rapidly because they permitted considerably heavier line loading and increased greatly the reliability of lines they controlled. The war economies they demonstrated can be realized in peace to such a degree as to warrant expectation of their retention and expansion, it was believed.

The war-born increases in kilowatt-hours per kilowatt output—from 4,600 in 1940 to 5,560 in 1944—was based largely on three factors, the OWU spokesman said, extra shifts in manufacturing plants, notably the third shift; lots of new industry, including some which virtually ran 24 hours a day, seven days a week; and War Time, which lowered evening peak loads. Since none of these factors is controlled by the electric power industry, the wartime level of kilowatt-hour per kilowatt output must drop as these factors drop.

Congressional figures who have been urging a decentralization of industry

throughout the war—mostly men from the South and Far West—will find a certain amount of comfort in the war power record, for the Northwest, California and South have had well the best of it, percentagewise, in kilowatts of capacity added during the war. By no means all of the industrial decentralization which occurred under the impact of war will be lost under peacetime conditions, it was predicted, even though some is bound to be wiped out by the tremendous decreases in airplane, aluminum and powder production which are inevitable after a war of such magnitude.

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Electric House Heating to Require Subsidization

Opinion that electric house heating must be subsidized in order to make it economical enough for the average home owner was voiced recently in Seattle, by Major S. E. Hutton, engineer, Bureau of Reclamation, Grand Coulee Dam.

In appraising the postwar Pacific Northwest power picture, Major Hutton disclosed that there will be blocks of surplus power at Bonneville and Grand Coulee and that at the present time there are no markets for that power. Answering proposals that the surplus be consumed by heating homes with electricity, Major Hutton said:

"The cost of transformers and other equipment needed for house heating is so great that electric rates would be too high to make it practicable."

Major Hutton spoke before the Seattle Junior Chamber of Commerce on the Columbia Basin Project.

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Nebraska Court Will Rule on P. P. D. Seizure by City

Legality of the condemnation of Consumers Public Power District properties at Bridgeport, Neb., by the city of Bridgeport will be tested in the State Supreme Court by the district. The properties were taken over by the district from the original owners, the Western Service Co.

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Utah Group May Expand

The Electrical League of Utah has changed its name to the Intermountain Electrical Association and may expand into adjoining states, President Ora H. Barlow has announced. The association now includes representatives of electrical wholesalers, contractors, manufacturers, dealers, and utilities.

Lee H. Hill Named Publisher of World

Allis-Chalmers Executive Will Replace W. K. Beard Who Becomes McGraw-Hill Vice-President

Lee H. Hill, vice-president in charge of industrial relations for the Allis-Chalmers Manufacturing Co., has been named publisher of ELECTRICAL WORLD to succeed William K. Beard, Jr., who will become a vice-president of the McGraw-Hill Publishing Co.

Malcolm S. MacNaught, now manager of *Electrical Contracting*, will take over additional duties as manager of ELECTRICAL WORLD. All appointments are effective as of September 1.

Mr. Hill, who was graduated from Cornell University in 1920 as an electrical engineer, has a broad background in the electrical industry. After serving as an instructor in the department of electrical engineering at Cornell until 1922, he became a transformer development and design engineer for Westinghouse Electric Corp. In 1928, he went to American Brown-Boveri Co. as manager of the transformer division. When Allis-Chalmers took over this firm in 1931, Mr. Hill remained as assistant engineer in charge of the transformer division and in 1936 became engineer in charge. As such he was in charge of both sales and engineering; later he was made assistant manager of the electrical department.

Lee H. Hill

In the Spring of 1941, following the bitter 76-day strike at Allis-Chalmers, the board of directors selected Mr. Hill to take charge of industrial relations making him vice-president at the same time.

Since that time, he has built a model industrial relations department, having responsibility for such matters as labor relations, employee training, wage policies, employment, safety, and medical and other employee services. Throughout the war, he has been active on the War Labor Board and was President Truman's first appointee as a full industry member of the board.

William K. Beard, Jr.

Mr. Hill holds a large number of patents relating to electrical machinery and is the author of a number of articles and textbooks in that field, having received recognition as an authority in the highly technical field of power and transformer design. With Charles Hook, Jr., he is co-author of a recently published McGraw-Hill book, "Management at the Bargaining Table."

The new ELECTRICAL WORLD publisher is a member of Phi Beta Kappa and of Eta Kappa Nu, honorary electrical engineering fraternity. He is a fellow of the A.I.E.E.

Mr. Beard in his new position will be in charge of company advertising activities, which include company promotion and research, customer relations and district office operations.

After graduating from the Wharton School, University of Pennsylvania, in 1919, Mr. Beard entered the textile industry. He joined McGraw-Hill in 1924 as a space salesman for *Electrical Merchandising* in the New York area. From 1925, until he was made manager of ELECTRICAL WORLD in 1935, he sold space in Chicago, Syracuse, and Cleveland for various company electrical magazines. In 1940, he was also made manager of *Electrical Contracting*, and in 1941, publisher of both.

Mr. MacNaught, who received his electrical engineering degree from Massachusetts Institute of Technology in 1924, served for a time as president of the Barnes-Pope Co., Boston. On January 1, 1936, he became a space salesman for *Electrical Contracting* and *Wholesaler's Salesman*. He became sales manager for the former in 1940 and manager in 1942.

Army Releases Surplus Power Stations for Sale

13 Industrial Power Plants Contain 66 Generating Units with Original Capacity of 149,550 Kw.—RFC Will Try to Sell Plants as a Whole, Real Estate Included—Interior Department Objections Expected

Thirteen industrial power stations are included in a list of 252 manufacturing plants which the Army announced last week it would release as surplus to the Surplus Property Board for disposition by the Reconstruction Finance Corporation.

The power plants originally had a total of 149,550-kw. of capacity, although some small units are known to have been moved out of their original stations for use elsewhere. It was not immediately known how much of the original capacity remained in place. The plants contained a total of 66 generating units, of which 28 were driven by steam turbines, the remainder by steam, gas diesel and internal combustion engines. Largest units were three 7,500-kw. steam turbines in the Missouri Ordnance Works, at Louisiana, Mo.

Entire Plants Will Be Sold

RFC officials said the plants had not yet been certified to their agency for disposal by the SPB. They said every attempt would be made to sell the plants as a whole, including the power facilities and as much of the real estate as possible. One indicated that it would be "quite a long time" before any of the electrical equipment in the plants would be sold separately.

It was not immediately clear to what extent conflict might arise between RFC's policy of attempting first to sell the plants as a whole and whatever desires the Interior Department, or other government agencies, might have toward acquiring certain surplus generating capacity. Interior is believed to be interested in acquiring either the equipment or the output of at least two of the power stations, those at surplus ordnance works at Pryor, Oklahoma, and Baxter Springs, Kansas. These are respectively about 40 miles south and about 80 miles north of the Grand River Dam on the Neosho River in northeastern Oklahoma. Grand River for the past two years has been under the jurisdiction, for power marketing purposes, of the Southwestern Power Administration, an Interior subsidiary which also markets power from Texas' Denison Dam and Arkansas' Norfork Dam. Grand River belongs to the Grand River Dam Authority, an Oklahoma instrumentality, and must be turned back to the Authority within six months after the official end of the war.

There is some reason to believe that the state might be content to have SPA market Grand River's energy in conjunction with other power sources of SPA, for the Authority was unable to market the power successfully before the war. Four 15,000-kw. hydro turbines are in place at Grand River, and the final unit is under construction.

Interior's interest in surplus power capacity arises from a statement by the late President Roosevelt, who in December, 1943, notified the Army, Navy and Defense Plant Corporation, as owners of war-installed power plants, that "I have in mind that such plants may be utilized after the war in connection with existing public power systems."

SPA currently obtains steam back-up for its exclusively hydro capacity from privately owned members of the Southwest Power Pool, and acquisition of the 40,000 kw. of steam to the north and south of Grand River Dam would go far toward freeing it of dependence on private power. Of the 40,000 kw. available in the two ordnance plants declared surplus, 10,000 kw. are in high back-pressure turbines which require an outlet for process steam before they can be used economically.

Whatever attempts Interior might make to obtain control of these or other generating plants would be bolstered by the Surplus Property Act, which provides a top priority for government agencies in the disposal of surplus property. It is this priority which conceivably could come into conflict with RFC's desire to sell the surplus plants, including power equipment, as a whole.

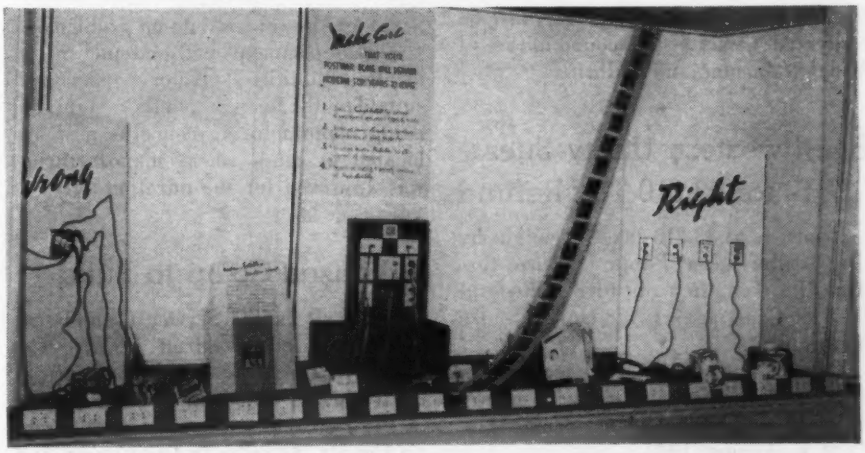
Power installations at plants recently declared surplus by the Army follow:

Place	No. of Units	Total Kw.
Kentucky Ord. Works Paducah, Ky.	1	500
Dixie Ordnance Works Monroe-Sterlington, La.	2— 750 C 3— 750 N 1—1,500 C 1—2,000 C	7,250
Gopher Ordnance Wks. Winona, Minn.	1 NR	300
Jayhawk Ord. Works. Pittsb'g-Baxter Spgs.	4—5,000 C	20,000
New River Ord. Works	2—6,000 CP	12,000
Pulaski-Radford, Va.	2—6,000 N•P	12,000
Cactus Ordnance Wks. Etter-Dumas, Texas	5—2,000 R	10,000
Oklahoma Ord. Works Pryor, Oklahoma...	2—5,000 C 2—5,000 N•	20,000
Ohio River Ord. Works Henderson, Ky.	3—3,500 C	10,500
Ozark Ordnance Works	11—1,000 G	13,000
Eldorado, Ark.....	2—1,000 N•	
Phillips Petroleum Co. Borger, Texas	18—1,000 G	18,000
Plumbrook Ord. Works Sandusky, Ohio	2—1,000	2,000
Missouri Ordnance Wks. Louisiana, Mo.	3—7,500 C	22,500
Keystone Ord. Works Meadv'le-Geneva, Pa.	1—1,500	1,500
Total	66	149,550

C—Condensing
N—Non-condensing
R—Reciprocating
P—Integral Part of Manufacturer's Plant
•—High Backpressure Units
G—Gas Engine

Texas Association Elects

Texas Power Reserve, statewide organization of rural electrical cooperatives, has elected the following officers: V. B. Shaw, Quitman, president; Raymond Perdue, vice-president; O. B. Bryan, secretary-treasurer; State Senator T. C. Chadwick, general counsel; and Riggs Sheppard, Glynn W. Scott, R. H. Hoffman, and M. L. Cowan, board members.



LESSON IN ADEQUATE WIRING—San Diego Gas & Electric Co. advises the public on what is needed to assure adequate wiring in the home

GOOD ADVICE, ANYTIME, ANYWHERE—"Put electricity to work on your farm," Delaware Power & Light Co. tells farmers who attended the Kent-Sussex Fair at Harrington, Del. In the booth at the right, an affiliated company, Eastern Shore Public Service Co. of Maryland, stresses the advantages of better living through better wiring

Saskatchewan Contracts for Extensions Awarded

Saskatchewan Power Commission has awarded contracts for the construction of two transmission lines. A 39-mile line will be built from Henchley to Fosston, interconnecting with the present system at Wadena, Rose Valley, and Kelvington.

A second line will be built to connect the Dominion Electric Co. system at Assiniboia with the commission's system at Willowbunch. Taps will be run to the villages of Willows, Verwood, and Readlyn where distribution systems will be built.

Part of this extension will be the 5 miles of line purchased from the National Defense for Air. This line which formerly served Lethburn Airport, east of Assiniboia, will be converted to a higher voltage.

The commission has also purchased lines serving the airfields of Ralph, Halbrite, and Chandler. These will be converted to serve the communities of Midale, Macoun, and Halbrite.

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Southwestern Utility Sues U. S. for $3,210 Tax Refund

Recovery of $3,210 taxes is sought by the Southwestern Public Service Co., Amarillo, Tex., in a suit filed in Federal District Court against the United States Government.

The utility asserts that the money represents an additional electric energy tax assessed and collected from May, 1939, to August, 1944.

The suit said the company's claim for a refund, which had been rejected, had been on the ground that the energy taxed was used for pasteurizing and bottling milk and did not represent commercial or domestic consumption.

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Los Angeles Power Will Give Reconversion Advice

Notice has been given to Los Angeles industries that the city's Department of Water & Power has set up a program of advisory services to aid business through the reconversion period, it was announced by General Manager Samuel B. Morris.

A group of experts is ready to extend aid in redesigning commercial premises and to advise on wiring, lighting, heat-treating and other electrical applications. The same group during wartime compiled and maintained a complete list of machines available for Los Angeles industries and contributed in other ways to solution of difficult wartime electrical and power production problems.

The department will extend aid in locating additional factory space and suitable sites for new plants. Many existing manufacturing concerns now are located in zones where manufacturing was approved for the duration only.

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Arkansas Co-op to Build

Arkansas Public Service Commission has authorized Woodruff Electric Co-operative Corp., to build 10 miles of rural lines in Woodruff County, 3 miles in Prairie County, 12 miles in St. Francis County, 13 miles in Lee County and 5 miles in Phillips County at a cost of $120,000.

Rural Line Policy Eased by Kansas City P. & L. Co.

Liberalization of the policy of the Kansas City Power & Light Co. on the construction of rural lines has been announced by Vice-President H. H. Kuhn. The new policy has been approved by the Kansas Corporation Commission and the Missouri Public Service Commission.

In any area where an average of 1.6 contracts per mile are secured and the last consumer on the line is not over 2,000 feet from the preceding consumer, service will be extended without a deposit or payment on the cost of the line.

The new plan provides for a minimum bill of $3.50 per month in rural areas plus an additional charge for any excess line extension. If the point of service to a consumer is more than 175 feet from a public highway or right of way along which the primary or secondary is built, then the minimum bill will be increased by 20 cents per month for each 100 feet, or fractional part thereof, of such additional line.

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SEC Denies Okin Request

Securities and Exchange Commission has notified Samual Okin, who owns 9,000 shares of Electric Bond & Share Co. common stock, that his request for oral argument on a trial examiner's ruling excluding him from personal participation in an Electric Bond & Share hearing has been denied.

The New York resident was excluded by SEC for "obstreperous and contemptuous conduct" but may be represented at hearings by counsel.

Falck and OWU Officials Take Peacetime Positions

Director Will Open Utility and Industrial Consulting Firm with Offices in New York and Washington—V. M. Marquis Will Join Pacific Gas & Electric Co.—J. E. Moore Will Return to Ebasco Services

Edward Falck, director of the Office of War Utilities which is winding up its war job to go out of business September 30, will open a utility and industrial consulting firm in October.

Falck disclosed he will have offices in New York and Washington. The organization will specialize in management and public relations work for electric and gas utilities, as well as industrial clients.

Falck has played a major part in the development and administration of the war utility program since before Pearl Harbor and is one of the oldest officials, in point of service, in the Government war agencies. He has headed the Office of War Utilities for the last sixteen months and before that had been its deputy director since its creation. He was largely responsible for the power rationing program worked out for the southeastern curtailment late in 1941, out of which grew Order L-94 and the comparable orders covering gas utilities, U-7 and L-174.

Served on Many Committees

In addition to directing the domestic war utility program, Falck had direct charge of the OWU work assisting the Army in planning for installation of equipment in occupied and recaptured countries. He is chairman of the Public Utilities Committee of the Combined Production and Resources Board, and chairman of the utilities sub-committee of the Technical Industrial Disarmament Committee, charged with recommending the policy for post-surrender treatment of the German power industry. Under his direction, also OWU sponsored a team of utility technicians which went to Germany last spring in search of German "know how" which might be of value to American utility manufacturers and operators.

For more than a year during the development and early administration of the Controlled Materials Plan, Falck also was assistant WPB priorities director under J. A. Krug, first OWU director and now WPB chairman.

Falck came to Washington from the position of assistant to John C. Parker, vice president of Consolidated Edison Co., to help Krug organize the Power Branch in the old Office of Production Management in 1941. Before joining Consolidated Edison, Falck had been Director of Rates and Research for the Tennessee Valley Authority. He is a graduate of Columbia University with an AB in 1930 and of Columbia School of Engineering with a BS in mechanical and electrical engineering and an MS in industrial engineering and public utilities. He also studied as a Columbia University Fellow in 1942 and 1943.

V. M. Marquis, head of OWU's Power Division since the first of the year, was to leave the organization soon after September 1 to become associated with the Pacific Gas & Electric Co. in a capacity as yet undisclosed.

Marquis joined the Power Branch of the old Supply, Priorities and Allocations Board in January, 1942, as a "dollar-a-year" man on loan from the American Gas & Electric Service Corp. He was western power supply engineer until last January, when he resigned from A. G. & E. to replace Barclay J. Sickler as head of the Power Division, a position he has held since.

J. E. Moore, deputy director of the Power Division and the senior member of OWU in point of service, will return to Ebasco Services, probably the first week in September. Moore joined J. A. Krug, then chief of the newly organized Power Branch of the Office of Production Management, in June, 1941, and was the second man in the organization. Starting as general consultant, he later became head of the Production Section, and headed the Power Supply Section from the time of its organization. He became deputy director of the Power Division last January.

C. W. Jones, chief of the Equipment Production Branch of the Power Division will return to the New England Power Association at the end of September. Jones joined the organization early in its history and served for more than two years, returning to the New England Power Association early this year. He returned to take over the Equipment Production Branch last June when its former head, Lester Bosch, went to China on a government mission.

Dr. Herschel F. Jones, assistant to Falck, will join the Bonneville Power Administration late this month as assistant to B. J. Sickler, head of the Division of Power Sales and Services. Sickler had been head of the Power Branch from the organization of OWU until last January.

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Utility Will Add Lines

Arkansas Power & Light Co. has been authorized by the Arkansas Public Service Commission to build 32 miles of rural line in Phillips County, 32 miles in Lee County, and 10 miles in St. Francis County at a cost of $58,840.

WASHERS ONCE MORE—When the first household washers built by General Electric since material restrictions were lifted, Jasper McLevy, mayor of Bridgeport, visited the plant to watch them come off the line. On the line, left to right, are Lloyd Hertzler, sales manager of G.E.'s home laundry division; John M. Wicht, manager of the division; Mayor McLevy; and W. Stewart Clark, Bridgeport works manager. Employment at the Bridgeport plant is of vital concern to the city

Priorities Regulation Sets Delivery Limit

New Inventory Control Measure Places Copper Wire and Solder under Rigid Restrictions

Priorities Regulation 32, which will control utility inventories after Order U-1 is revoked September 30, provides, with limited exceptions, that "a person may not accept delivery of any material if his inventory of that material is, or will be, more than a practicable working minimum inventory reasonably necessary to meet his own deliveries on the basis of his current or scheduled method and rate of operation."

Suppliers are forbidden to make deliveries which they know or believe would, if accepted, be in violation of the regulation.

Principal item of electric utility interest on PR 32's list of materials in short supply and consequently subject to specific inventory controls is copper base alloy and copper, all of whose controlled materials forms are listed in Table 1 as being scarce, and are subject to a 60-day limitation on inventory or to practical working minimum inventory, whichever is smaller. This limitation includes wire, cable and foundry castings of copper or copper base alloy.

Poles Not Included on List

Poles were not included on the list of items in short supply, but solder was, and inventories of it are governed, according to PR 32, by Direction 2 to Order M-43.

In Table 3, a list of items exempted from the restrictions of PR 32, is included aluminum in all forms and a number of other products.

It was emphasized that restrictions on ordering more material than needed, which formerly applied only to rated orders, now apply to all orders except those for materials listed in Table 3 as being in plentiful supply.

WPB officials pointed out that materials now tight will be removed from Table 1 as rapidly as possible and that materials in ample supply will be added to Table 3 as rapidly as possible. The over-all inventory control regulation, however, will be retained "until materials are generally in ample supply."

Purchasers are not permitted to place orders for materials in greater quantities than they would be permitted to receive under PR 32 even if they intend to cancel one or more of them before delivery. This restriction does not apply to orders for any material in Table 3, however.

Where a purchaser's operations are changed through cutbacks or for other reasons after orders of materials have been placed, outstanding orders, acceptance of which would put him in violation of PR 32's inventory limits, must be adjusted promptly. If necessary, deliveries must be postponed or cancelled.

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Water Supplies Now Ample

Water supplies throughout the United States and Canada were ample in most sections following the heavy rains of July, the United States Geological Survey and the Dominion Water and Power Bureau reports.

Subnormal water-supply conditions prevailing in the Southeast for many months were materially improved, especially in peninsular Florida. Storage reserves in South Carolina are about exhausted as a result of seven months of subnormal runoff.

Runoff in the Columbia Basin, New Mexico, and southern Arizona continued subnormal.

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Municipal Lease Extended

The Conway, Ark., City Council has voted a 25-year extension of the franchise and lease to the Conway Corp., operators of the municipal-owned light and power plant. The extension becomes effective July 1, 1949, when the present lease expires. Annual rental will be $9,000.

MEETINGS

Maryland Utilities Association—Mid-year meeting, Lord Baltimore Hotel, Baltimore, Md., September 21. R. C. Brehaut, Secretary, 1100 H St., N.W., Washington, D. C.

International Association of Electrical Inspectors—Northwestern Section, Monticello Hotel, Longview, Wash., September 24-25; W. L. Gaffney, secretary, Room 402, City Hall, Tacoma 2, Wash. Southwestern Section, Pacific Gas & Electric Bldg., San Francisco, Calif., October 1, and Southern California Edison Co. Bldg., Los Angeles, October 3; H. L. Gerber, secretary, Room 205, City Hall, San Francisco, Calif. Western Section, LaSalle Hotel, Chicago, Ill., October 15-16; F. H. Moore, secretary, 320 N. Meridian St., Indianapolis, Ind. Eastern Section, Hotel New Yorker, New York, N. Y., October 22-23; F. N. M. Squires, secretary, 85 John St., New York, N. Y. Southern Section, Ansley Hotel, Atlanta, Ga., October 29-31; A. M. Miller, secretary, 219 Governor St., Richmond 19, Va.

Pennsylvania Electric Association—Annual meeting, Benjamin Franklin Hotel, Philadelphia, Pa., September 26-27; A. B. Millar, managing director, State St. Bldg., Harrisburg, Pa. Electrical equipment committee (tentative), Benjamin Franklin Hotel, Philadelphia, Pa., October 25-26; B. E. Hagy, chairman, Philadelphia Electric Co., Philadelphia, Pa. Systems operation committee, Penn Harris Hotel, Harrisburg, Pa., November 8-9; A. R. Deck chairman, Metropolitan Edison Co., 412 Washington St., Reading, Pa.

Indiana Electric Association—Annual meeting, French Lick Springs Hotel, French Lick, Ind., September 27-28. E. F. Hauser, executive secretary, 1414 Circle Tower, Indianapolis, Ind.

American Welding Society—Annual meeting, Pennsylvania Hotel, New York, N. Y., October 18; M. M. Kelly, secretary, 33 W. 39th St., New York 18, N. Y.

Truman and Krug Agree to Abolition of War Time

The end of War Time appeared this week to be only a short time off as President Truman indicated that he would recommend its discontinuance and WPB Chairman J. A. Krug notified Congressional leaders that the end of the Japanese War obviated its necessity as a fuel-saving measure.

With several Congressional leaders, led by Rep. Clarence Cannon, Missouri Democrat, sharpening their knives for the measure against which they have fought for more than a year, it was anticipated there would be little delay in bringing a repealer to the floor. Passage of a concurrent resolution by both Houses would be sufficient to end the measure which has been in effect since January 20, 1942.

Mr. Truman did not disclose what his recommendation on War Time to the returning Congress would be, but there was little doubt that it would be an unqualified endorsement of repeal.

In letters to Senate President Kenneth McKellar and House Speaker Samuel Rayburn, Krug revised the position he took following the defeat of Germany when he asserted that War Time had no further utility as a power measure but recommended that it be retained until Spring as a fuel-saving measure. Cutbacks resulting from the Jap defeat, he said, obviate the need of its retention.

•

Annual Demand for Poles Now Estimated at 7,200,000

Utility pole demand now has reached a level of about 7,200,000 units per year for the next three years, and this year's output is not expected to exceed 60 percent of that figure, although prospects of vastly increased output in 1946 and subsequent years are regarded highly, an official of the Office of War Utilities has reported.

Considerable activity is arising in the electric power field aimed at improving pole supply prospects. Some power suppliers are thinking of establishing their own pole-treating plants while others are considering or making long-term contracts for pole deliveries. Others are sending crews into the woods marking poles for future cutting. The trend, which received a boost by the allocation by the Rural Electrification Administration last winter of several hundred thousand dollars for a cooperative pole-treating plant in Texas, is believed to be growing substantially.

An OWU official declared that long-term contracts for pole deliveries should meet the restrictions of PR 32.

$65,000,000 Program Announced by Utility

As a part of a $65,000,000 five-year construction program, Pennsylvania Power & Light Co. has announced that plans are under way for the construction of the largest and most economical anthracite coal burning power plant in the world at Sunbury, Pa.

The plant along the Susquehanna River will have two 70,000-kw turbo-generators. Very small sizes of anthracite coal will be used as fuel and pulverized and burned in four boilers, operated at steam pressure of 1,350 psi. It is not expected to have the plant in operation before Spring of 1949.

The program also provides for additions to power plants, additions and improvements to transmission lines, additional substations, renovations and improvements to manufactured gas plants, and the extention of rural lines.

•

Pennsylvania Power Co. Announces Building Plans

Pennsylvania Power Co. will double the present rated capacity, 35,000 kw., of its West Pittsburgh plant by the installation of a turbo-generator, boilers, transmission facilities, and other equipment. Louis B. Round, vice-president and general manager, in making the announcement placed the cost at $3,200,000.

•

Energy Production Up

Electric energy produced for public use in June, 1945 totaled 18,832,491,000 kw.-hr., an increase of 1.3 percent when compared with June, 1944, while combined production of utilities and industrial establishments of the country was 22,999,016,000 kw.-hr. during the same period, an increase of 0.8 percent over June of last year, according to a report issued by the Federal Power Commission. Average daily production of electric energy for public use in June was 672,589,000 kw.-hr., an increase of 0.8 percent when compared with the average daily production during the previous month.

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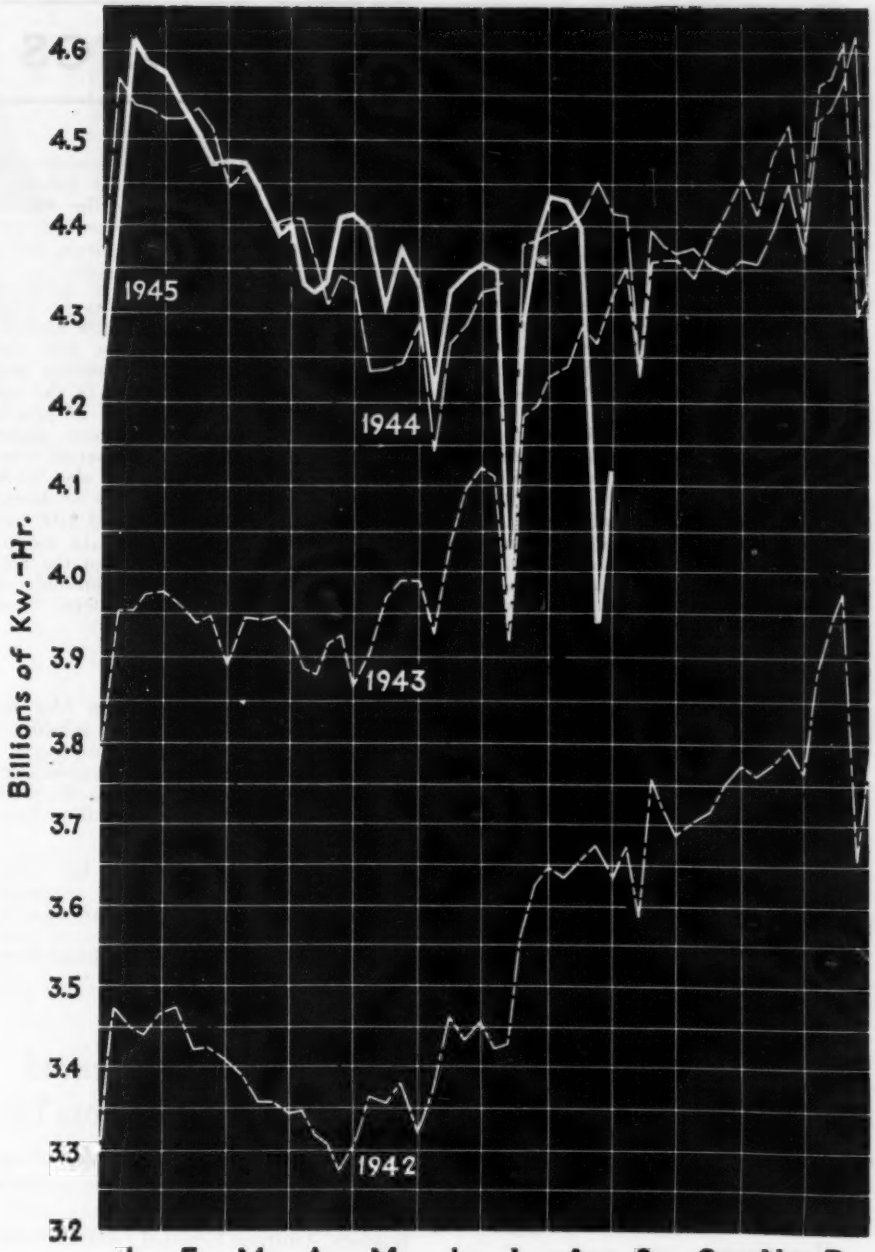
Co-op Buys Utility Division

Sale of the Socorro Division of the New Mexico Public Service Co. to the Socorro Electric Cooperative, Inc. has been approved by the New Mexico Public Service Commission. The co-op plans to expand the lines to serve additional rural customers.



Output Curve Indicates Reconversion Trend

The likely trend of electrical energy output during the reconversion period is indicated in the distribution figures for the week ended August 25, released by Edison Electric Institute. The total, 4,116,049,000 kw.-hr., was the lowest of any non-holiday week in a little over two years. Output in the week ended August 26, 1944 was 4,418,298,000 kw.-hr.; the figure for the "victory" week ended August 18, 1945 was 3,939,195,000 kw.-hr.

The decrease of 6.8 percent over the figure for the corresponding week of 1944 was reflected in all geographical sections of the country. In the Central Industrial States, the decrease was highest, 13.7 percent; the Southern States with a decrease of only 1.1 percent made the best showing.

Weekly Output Millions Kw.-Hr.

1945		1944		1943	
Aug. 25	4,116	Aug. 26	4,418	Aug. 28	4,322
Aug. 18	3,939	Aug. 19	4,451	Aug. 21	4,265
Aug. 11	4,395	Aug. 12	4,415	Aug. 14	4,288
Aug. 4	4,432	Aug. 5	4,399	Aug. 7	4,241
July 28	4,435	July 29	4,391	July 31	4,227
July 21	4,385	July 22	4,381	July 24	4,196
July 14	4,295	July 15	4,377	July 17	4,184
July 7	3,978	July 8	3,941	July 10	3,919
June 30	4,353	July 1	4,327	July 3	4,111
June 23	4,358	June 24	4,325	June 26	4,120
June 16	4,348	June 17	4,287	June 19	4,098
June 9	4,327	June 10	4,265	June 12	4,040

Percent Change from Previous Year

	Week Ending		
	Aug. 25	Aug. 18	Aug. 11
New England	— 6.5	— 19.3	— 2.6
Mid Atlantic	— 3.2	— 12.5	+ 1.7
Central Industrial	— 13.7	— 18.8	— 4.6
West Central	— 3.7	— 6.0	+ 0.8
Southern States	— 1.1	— 1.6	+ 6.2
Rocky Mountain	— 7.0	— 11.7	— 3.9
Pacific Coast	— 6.1	— 8.9	— 2.1
Total United States	— 6.8	— 11.5	— 0.5

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission in a series of orders recently issued affecting electric utility companies:

APPROVED CONDITIONALLY a plan filed by the Peoples Light & Power Co. designed to acquire the assets and assume the liabilities of its subsidiary, the Texas Public Service Co., and to reclassify its outstanding preferred stock and its class A and class B common stocks into a single class of new common stock. Under the plan Peoples would then change its name to Texas Service Public Service Co. and would become solely a public utility company operating wholly within Texas and would cease to be a holding company. The commission held that the electric, water and ice properties at La Grange, Tex., were not retainable with the natural gas properties at Galveston, Austin and Port Arthur, Tex., and that the La Grange properties must be divested by Peoples. The commission also held that Peoples could not retain its interest in the farm business of Texas Public Service Farm Co., which owns and operates a rice farm and warehouses for storage of rice in Jefferson County, Tex. The commission did not approve the proposed $1 dividend payment, $29,145 of which was to be paid to Class A and B stocks. The commission stated that when and if the plan is so amended and approved, it would seek court approval and enforcement of the plan as requested by the company.

GRANTED PERMISSION to the North American Co. to pay on October 1 a dividend to holders of its common stock of record on September 4. The dividend is payable in the $25 par value common stock of the Pacific Gas & Electric Co., presently held by North American, at the rate of one share of Pacific common for each 100 shares of North American common outstanding. Fractional share of Pacific common will be paid in cash at the rate of 41 cents for each 1/100 of a share.

HAS APPROVED joint proposal of International Utilities Corp. and its subsidiary, General Water Gas & Electric Co., to reclassify common stock of Rockland Gas Co., Inc., a General Water Gas subsidiary, and sale by latter of its interest in the unit.

Applications Filed

INTERSTATE POWER CORP. has filed a reorganization plan designed to simplify its capital structure by converting it into debt and common stock, to provide an equitable distribution of voting power among its security holders and comply with certain orders of the commission. The corporation's parent, the Ogden Corp., holds $100 of its 6 percent gold debentures, a 6 percent demand note for $2,475,000, 12,568 shares of its preferred stock and all of its common stock. Under the plan just filed Interstate Power would have a capitalization of $19,000,000 of new first mortgage bonds and 3,000,000 shares of new common stock, par value $3.50 a share. The new bonds would be sold by competitive bidding. As of the effective date of the plan, the excess of cost to Interstate Power of utility plants over original cost would be written off. The commission is to determine the validity of the indebtedness of Interstate Power to the Ogden Corp. with respect to the note and the $100 debenture, as well as Ogden's rights with respect to the preferred stock.

CONSOLIDATED ELECTRIC & GAS CO. and its subsidiary, Roanoke Railway & Electric Co., have filed an application with the commission proposing that Roanoke pay to Consolidated not to exceed in the aggregate $75,000 as a reduction of principal on a $1,538,000 demand note, dated Jan. 1, 1935 and held by the parent company. At present Consolidated also holds all of the outstanding securities of Roanoke, consisting of 5,000 shares of $100 par value common stock. All of said securities are pledged under a lien of the collateral trust, indenture of Consolidated securing its outstanding collateral trust bonds.

Hearings Scheduled

SEPTEMBER 4: On application filed by General Gas & Electric Corp., a subsidiary of Associated Gas & Electric Co., requesting permission to pay out of unearned surplus a quarterly dividend on its $5 prior preferred stock for the period ending Sept. 15, 1945.

DECEMBER 18: Commission has postponed to this date a hearing, originally scheduled for August 18, on plan filed by Consolidated Electric & Gas Co. in compliance with provisions of Holding Company Act.

•

Arizona Utilities Required to Give Stockholders List

The Arizona Corporation Commission has authority to require public utilities to furnish a list of the company stockholders, Attorney General John L. Sullivan has ruled.

The ruling followed a request of the commission to the Central Arizona Light & Power Co. for a list of stockholders which brought a reply that some stockholders objected to being listed.

UTILITY REPORTS

	Net Income 1945	1944
*Central Arizona Lt. & Pwr.	$786,387	$787,174
†Central Maine Power	3,126,668	3,226,573
†Dayton Power & Light	1,943,859	1,549,177
*Detroit Edison and subs	6,198,344	8,441,580
†Louisville Gas & Electric and subs	2,681,799	2,929,146
†Oklahoma Gas & Electric	2,421,845	2,592,032
†Pacific Gas & Electric	21,774,755	23,269,579
†Rochester Gas & Electric	2,863,624	2,918,832
*Texas Electric Service	2,069,362	1,527,016
†Union Electric (Missouri) and subs	8,358,075	8,001,335
†West Penn Power and subs	6,030,823	5,799,712
†Wisconsin Electric Power and subs	4,282,280	4,088,624

*Twelve months ended July 31.
†Twelve months ended June 30.

Electric Revenues Rise 2.9% in June

Electric operating revenues of the larger privately-owned electric utilities in the United States in June, 1945 were $261,655,000, compared to $254,204,000 in June, 1944, an increase of 2.9 percent, according to figures announced by the Federal Power Commission.

Revenue deductions (including operating expenses, depreciation and taxes) were $205,177,000 or 3.2 percent over those of June, 1944.

Gross income, including other utility operating income, increased 2.0 percent to $67,283,000 and net income in June, 1945 was $42,241,000, an increase of 2.5 percent over the net for June, 1944.

•

Indiana Utilities Contribute to State Advertising Fund

Eleven Indiana electric and gas utilities have made a gift of $31,000 to the Indiana Department of Commerce and Public Relations to be used for a national advertising campaign featuring Indiana's industrial advantages.

Electric utilities underwriting the gift were the Public Service Co. of Indiana, Northern Indiana Public Service Co., Indianapolis Power & Light Co., Indiana-Michigan Electric Co., Southern Indiana Gas & Electric Co., Indiana Service Corp., Southeastern Indiana Power Co., and Madison Light & Power Co.

•

Rural Extension Program Revealed by Appalachian

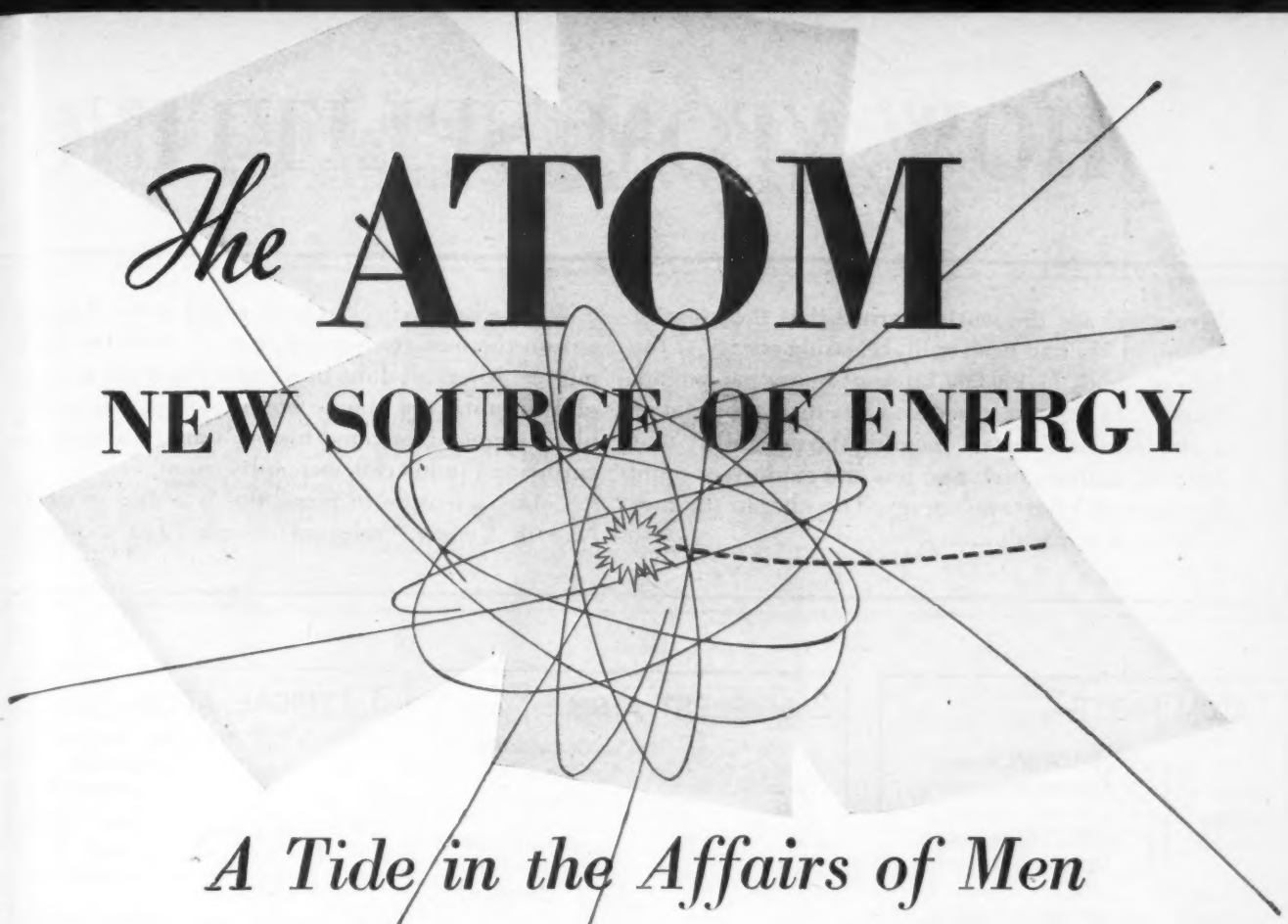
Appalachian Electric Power Co. through its vice-president and general manager, M. C. Funk, has announced that it will construct 4,288 miles of rural lines to serve 18,260 farms and rural customers. The company will supply electric service to any farm or rural customer with the monthly minimum set at $2.

•

Carolina Power & Light Signs Contract with City

Louisburg, N. C., has signed a ten-year contract with Carolina Power & Light Co. under which the utility will sell power to the city at wholesale rates. The utility also has the privilege of serving customers with over 50-kw. demand.

The ATOM
NEW SOURCE OF ENERGY



A Tide in the Affairs of Men

On August 6, 1945, an atomic bomb exploded over the Japanese city, Hiroshima.

Its concussion blasted the city, vaporized the fibre of Japan's will to resist, and flashed across the world a light of such glaring intensity that even blind eyes could glimpse the forked road that is presented to humanity's choice and destiny.

It has been a scant fifty years since Pierre and Marie Curie embarked upon their research with the avowed intent of discovering "how the atoms of the universe are put together". Their work contributed radium to the knowledge and use of mankind, but it marked only a way station upon the awesome quest which they announced and which thousands of scientists have since pursued.

Under the compelling stimulus of war, the first major application of the release of atomic force has been in an instrument that raises by an unimaginable dimension our ability to dole out death. We can be devoutly grateful that the scientific leadership of the Allies, and particularly the industrial strength of the United States, brought to us, rather than to our enemies, priority in the development of this dread weapon. But even in its present infant phase, it is clear that ownership of the principle of the atomic bomb carries a trusteeship of terrifying gravity.

We hold in trust a power that is capable of unraveling the very fabric of our civilization. Equally, it may be susceptible of development as a mighty force for human welfare. But we have proved the destructive use, while the constructive applications are still in the realm of speculation.

Clearly the trust is of a magnitude that transcends national jurisdiction. No walls have ever been built high enough to fence in the spread of scientific knowledge, and even if we were resolved to forego the harnessing of atomic power for peace, it is hopeless to think that its application for war can be held for long as the monopoly of one, or a small group of nations.

At one giant stride our scientific and technological development has so far outdistanced our social engineering, that we have no choice but to turn our full powers of creative imagination to control the forces we have unleashed and to bend them to man's use rather than to his destruction.

Since control is not possible without understanding, I have asked several of my editorial colleagues in the McGraw-Hill organization to present on the pages which follow a non-technical but authoritative account of the known facts and implications of atomic power.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Co., Inc.

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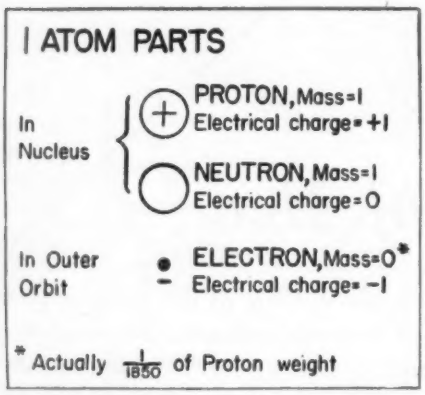
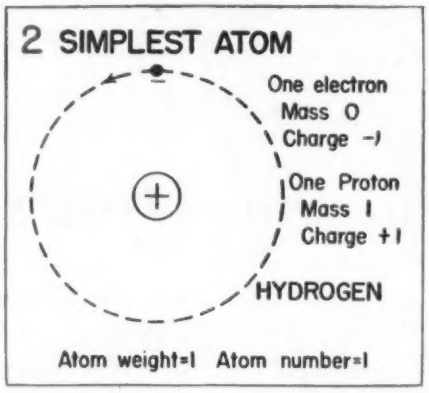
HOW ATOM SPLITTING

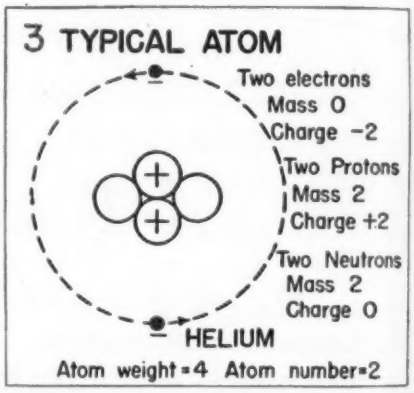
Five years ago the world learned that the atom of Uranium 235 had been split, releasing energy at the rate of about 11,400,000 kilowatt-hours per pound. The whole amount tested was less than the head of a pin, but there was no escaping the possibility that heaters, engines, turbines, jets and explosives could be powered by atomic energy. Then began the race to win the war with atoms.

With what help England could give, America outran the best atom-splitting team Germany could muster. It was all done in silence. From the summer of 1940 until the atomic bomb blasted Hiroshima, black secrecy blanketed history's most amazing scientific and industrial accomplishment.

Coldly scientific in form, the War Department's "Smyth Report," released August 12, 1945, traces

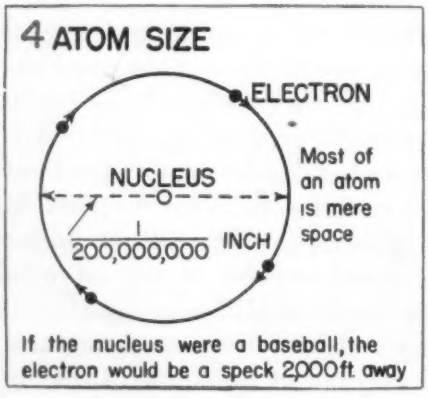


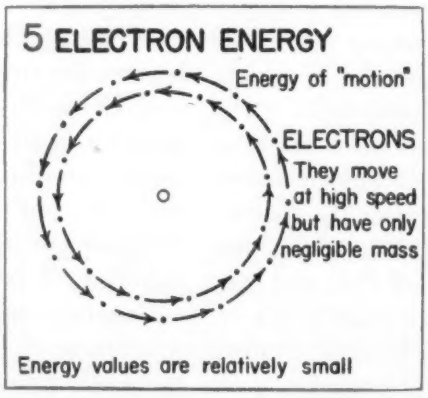


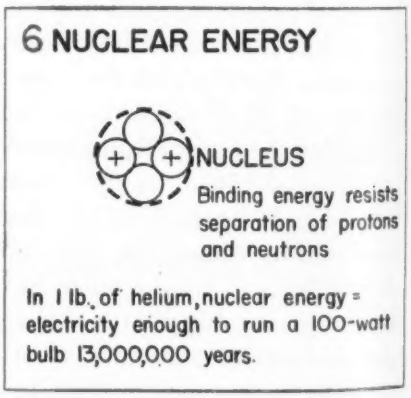


Each of the 92 elements has its own *atom*, yet all atoms are made from the same three pieces, Fig. 1: *proton* (weight 1, electric charge +1), *neutron* (weight 1, charge 0), *electron* (weight 0, charge −1).

Every atom is a tiny "solar system." Its central "sun" has one or more protons, generally neutrons too. The revolving "planets" are electrons, one for each proton in nucleus, because plus and minus must balance in the atom. The opposite charges attract, but high speed keeps the electrons out in their circular orbits, just as the centrifugal tendency of the revolving earth defies the sun's gravitational pull. All the weight of an atom is in the nucleus, so add the number of protons and neutrons to get the atom's weight. The *atomic number* is equal to the number of protons. The elements are known by their atomic numbers. Thus uranium (92 protons) is element 92.


4 ATOM SIZE
ELECTRON
NUCLEUS
Most of an atom is mere space
1/200,000,000 INCH
If the nucleus were a baseball, the electron would be a speck 2,000 ft away


5 ELECTRON ENERGY
Energy of "motion"
ELECTRONS
They move at high speed but have only negligible mass
Energy values are relatively small


6 NUCLEAR ENERGY
NUCLEUS
Binding energy resists separation of protons and neutrons
In 1 lb. of helium, nuclear energy = electricity enough to run a 100-watt bulb 13,000,000 years.

With only their outermost orbits touching, it would take half a million atoms to span the thickness of a human hair. Yet if one could expand an atom until its outer orbits encircled 100 acres, the nucleus would be no bigger than a baseball. The atom is mostly empty space, Fig. 4, and nuclei are difficult targets; so much so that a neutron bullet fired at a mass of atoms may pass right through without a hit.

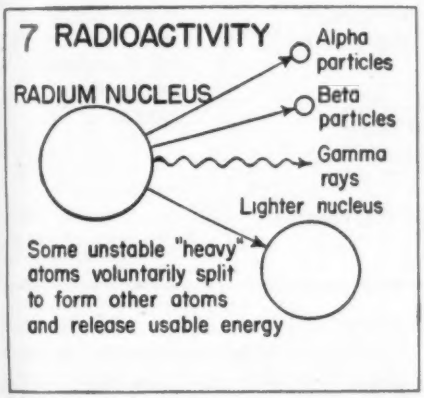
The almost weightless speeding electrons, Fig. 5, supply all the energy of chemical reactions (as when coal burns or TNT explodes). Evading all ordinary chemical action, the immensely greater energy bound up in the nucleus, Fig. 6, can be released only by direct hits on the nucleus to break the bonds that hold the protons and neutrons in a tight bundle.

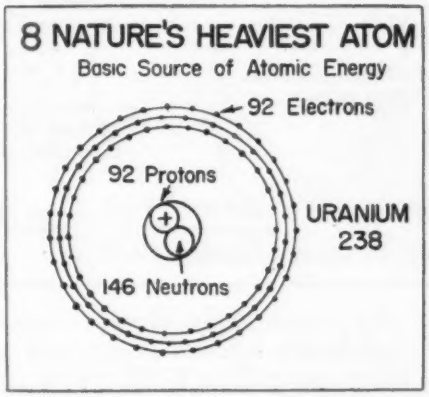
RELEASES ENERGY

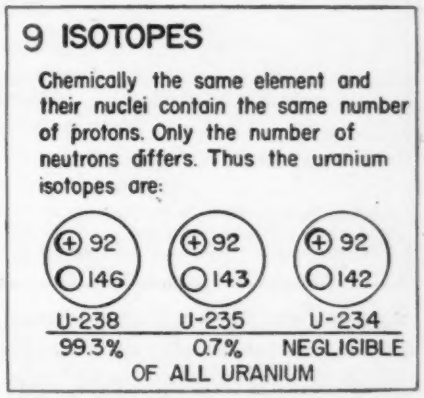
the fantastic course of atomic engineering through the five years of news blackout. It leaves no doubt that only a complete mobilization of America's technical resources could have won this victory in time.

Other writers in other places will unfold the epic story. This presentation leaves no space to reflect the glory of the accomplishment or even to record its history. The aim is more immediately practical — to give the professional and business readers of the McGraw-Hill publications a sound and honest, though non-technical, understanding of this atom-smashing business, so that they will know better what to do about it in their personal and business lives.

Now for step one: learning the shape of atoms and how atom splitting releases energy.

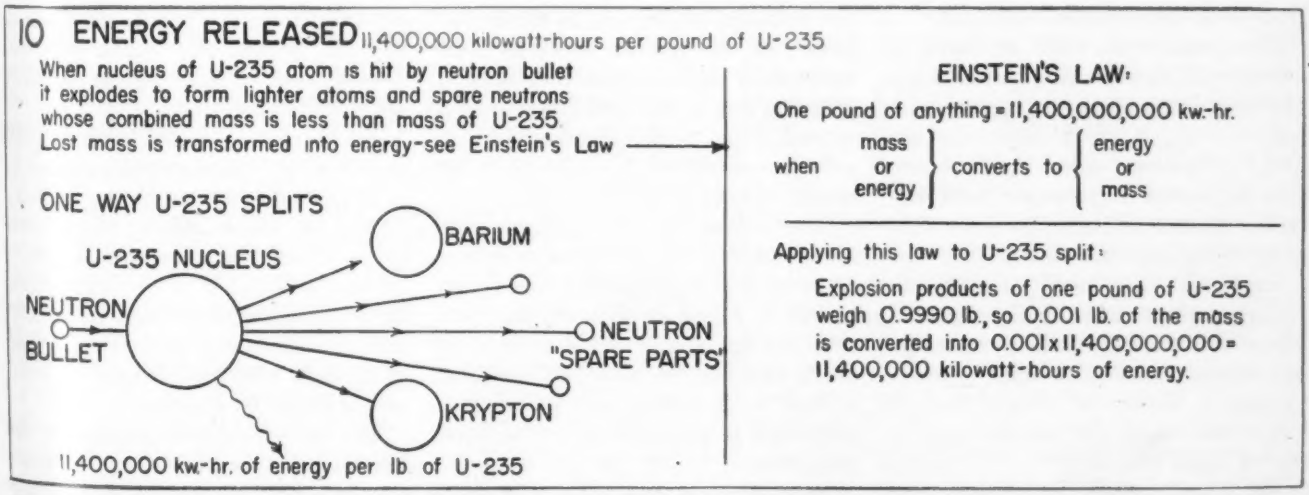






Radium nucleus, Fig. 7, automatically emits particles and energy as it decays to form nuclei of a lighter atom. Most common form of uranium, nature's heaviest atom, is Uranium 238, Fig. 8. This form is not directly useful for energy release, but is important as the raw material for a new synthetic power atom, *plutonium*.

An element may have several *isotopes* — alternate forms with the same number of protons but slightly different numbers of neutrons. Uranium 238 is the isotope in which protons and neutrons total 238 (so atom weight is 238). It is 99.3% of the total weight of pure, natural uranium. The stuff needed for direct atomic-energy release is Uranium 235, only 0.7% of the total weight and very difficult to separate from 238. To put it another way, every pound of energy-giving U-235 comes mixed with a dead load of 140 pounds of relatively inert U-238.

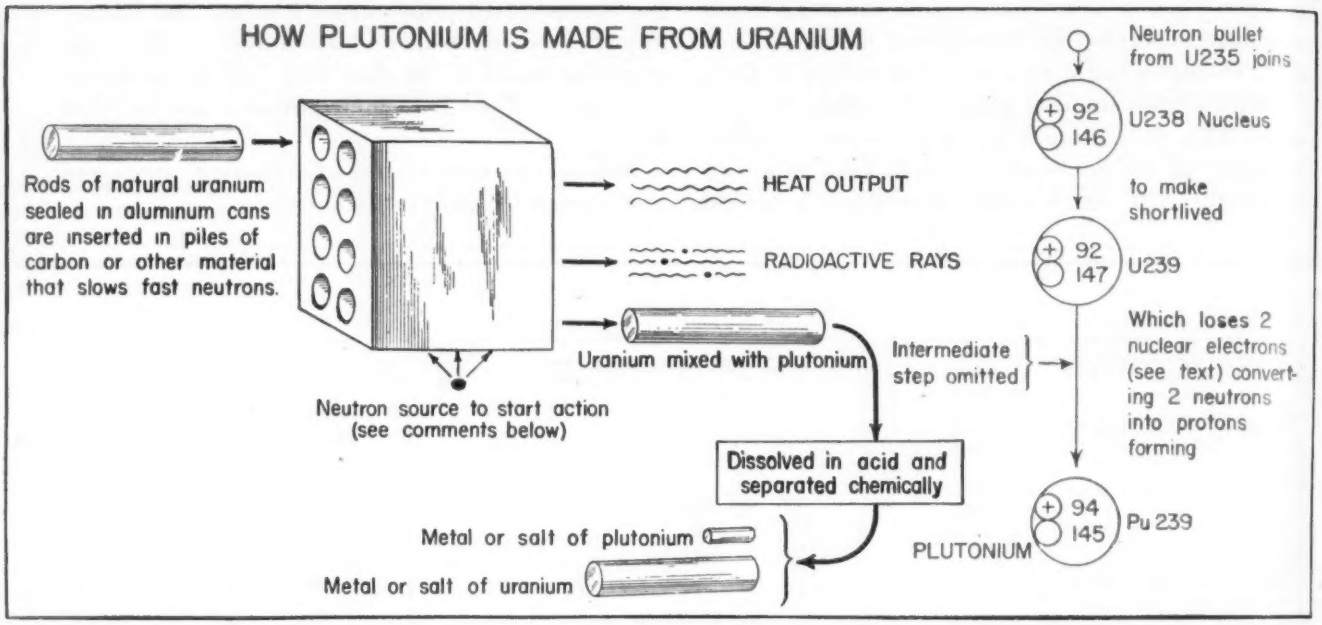

10 ENERGY RELEASED 11,400,000 kilowatt-hours per pound of U-235
When nucleus of U-235 atom is hit by neutron bullet it explodes to form lighter atoms and spare neutrons whose combined mass is less than mass of U-235. Lost mass is transformed into energy-see Einstein's Law
ONE WAY U-235 SPLITS
U-235 NUCLEUS
NEUTRON BULLET
BARIUM
NEUTRON "SPARE PARTS"
KRYPTON
11,400,000 kw-hr. of energy per lb of U-235
EINSTEIN'S LAW:
One pound of anything = 11,400,000,000 kw-hr.
when mass or energy converts to energy or mass
Applying this law to U-235 split:
Explosion products of one pound of U-235 weigh 0.9990 lb., so 0.001 lb. of the mass is converted into 0.001 x 11,400,000,000 = 11,400,000 kilowatt-hours of energy.

Slow neutron bullet splits Uranium 235 nuclear target, generating two lighter atoms (Fig. 10 shows one possibility) and several free neutrons ready to split other U-235 atoms. The following pages show how the original neutron may be produced and directed and how a chain of self-propagating atomic explosions may sweep through a block of U-235 like a forest fire to release heat energy equivalent to 11,400,000 kilowatt-hours per pound.

CONTINUED ON NEXT PAGE

CREATING and ISOLATING

Man-Made Plutonium—U-235 Substitute


HOW PLUTONIUM IS MADE FROM URANIUM
Rods of natural uranium sealed in aluminum cans are inserted in piles of carbon or other material that slows fast neutrons.
HEAT OUTPUT
RADIOACTIVE RAYS
Uranium mixed with plutonium
Neutron source to start action (see comments below)
Dissolved in acid and separated chemically
Metal or salt of plutonium
Metal or salt of uranium
Neutron bullet from U235 joins
92 146 U238 Nucleus
to make shortlived
92 147 U239
Intermediate step omitted
Which loses 2 nuclear electrons (see text) converting 2 neutrons into protons forming
94 145 Pu 239
PLUTONIUM

We now have two kinds of atoms suitable for energy supply, Uranium 235 and the new man-made element No. 94, plutonium. Uranium, No. 92, has the heaviest atom of any natural element.

The Manhattan Project's plant, on the Columbia River at Hanford, Washington, is the world's greatest atom-making factory. Devoted entirely to the mass production of plutonium atoms, it uses U-238 as the raw material and U-235 as the energy source, intimately mixed in the same proportions as in natural uranium metal.

The production units at Hanford are several huge uranium "piles." Each is a very large block of graphite with holes in which are placed uranium-metal cylinders, sealed in aluminum cans to protect the uranium from corrosion by the cooling water constantly pumped through the pile.

Each pile runs itself, so to speak. Not even the conventionally pictured bits of radium, beryllium and paraffin are needed as a "pilot light" to start operation. There are always enough stray neutrons, or even cosmic rays, to start a chain reaction.

But once started, the design, size and control of the unit must be such that the chain reaction will continue at an even rate — neither die down nor overshoot into an explosion.

To see this picture in atomic terms, consider the fraction of a second in which one million U-235 nuclei are split, producing two million lighter atoms (say, one million of barium and one million of krypton) and between one and three million fast-moving neutron projectiles.

Some of these escape in free flight right through the relatively vast atomic "open spaces." Some are "captured" by the many U-238 nuclei, and others are captured by the impurities. But, on the average, of the one to three million, just one million neutrons must succeed in smashing another million U-235 atoms in the next fraction of a second. Thus, with reproduction rate exactly maintained, life goes on in the atomic-energy pile.

The carbon, one of several possible "moderators," serves to slow down the neutrons without capturing many. The chance of a fast, straight-moving neutron hitting a tiny nucleus is very small, whereas the "slow ball" neutron is likely to be sucked in by the nuclear attraction if it would otherwise be a near miss.

From the practical angle, maintaining a chain reaction requires careful design and good controls. The pile must be slightly larger than actually necessary for a chain reaction (that means scores of tons of material). Controls must be sensitive and dependable. They slow the pile down to the balancing point by sliding in retarders, such as strips of cadmium.

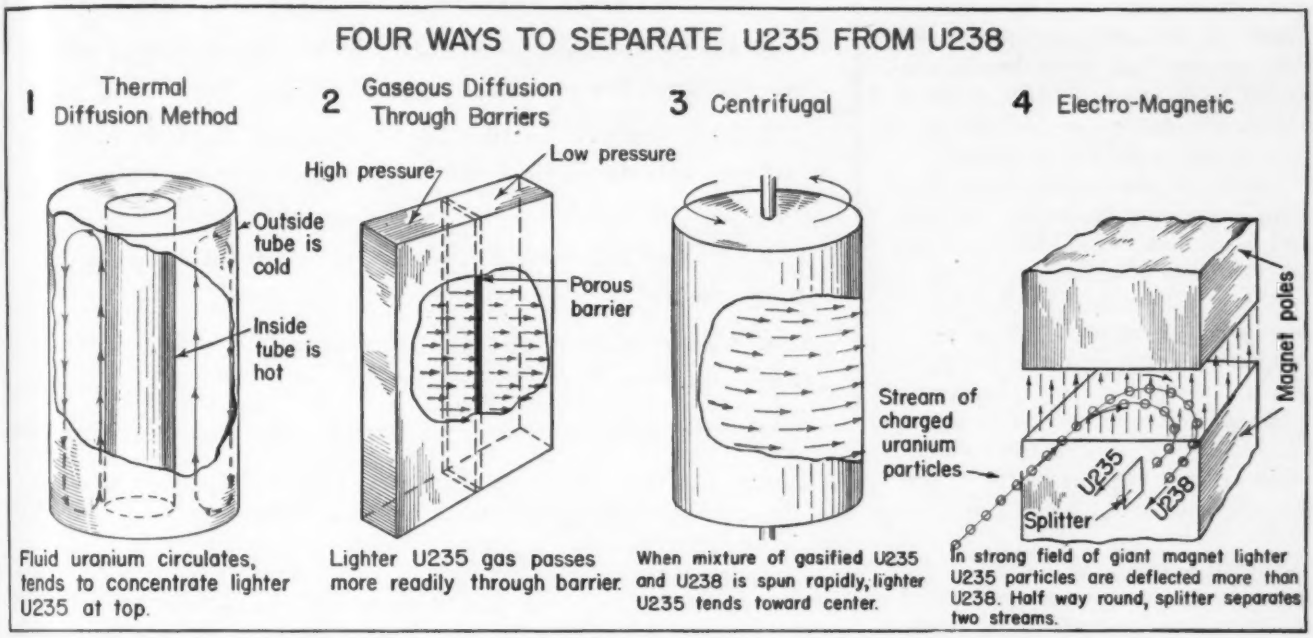
As already noted elsewhere, the energy released is about 11,400,000 kilowatt-hours for each pound of U-235 split. This energy appears first in the high speed of the pieces thrown off by the atomic split, then is converted to sensible heat as collisions slow down these projectiles. The energy is finally removed from the pile in the form of hot air, steam, hot water or other heated fluid in commercial quantity and thermal condition.

Such piles, operated with normal uranium, or with uranium enriched in U-235, would seem to be the primary means by which atomic energy will serve (if ever) as a commercial source of heat and power. Plutonium would be a byproduct, but might under certain conditions add to the energy yield of the pile without the need to separate it from the uranium.

The use of normal uranium in the Hanford pile sounds extremely attractive as a heat source, but has certain economic disabilities. Only a small part of the U-235 is used up before the pile must be shut down to remove the plutonium.

THE HIGH-POWER ATOMS

Isolating U-235 — a Gigantic Task


FOUR WAYS TO SEPARATE U235 FROM U238
1 Thermal Diffusion Method
2 Gaseous Diffusion Through Barriers
3 Centrifugal
4 Electro-Magnetic
Outside tube is cold
Inside tube is hot
High pressure
Low pressure
Porous barrier
Stream of charged uranium particles
U235
U238
Splitter
Magnet poles
Fluid uranium circulates, tends to concentrate lighter U235 at top.
Lighter U235 gas passes more readily through barrier.
When mixture of gasified U235 and U238 is spun rapidly, lighter U235 tends toward center.
In strong field of giant magnet lighter U235 particles are deflected more than U238. Half way round, splitter separates two streams.

Many of the uranium ores, including most samples of pitchblende and carnotite, will yield from 1 to 15% metallic uranium. Chemical separation of the metallic "natural" uranium is simple. Whatever the source, natural uranium contains the three isotopes in the constant proportions of 99.3% U-238 and 0.7% U-235, with traces of U-234.

Separating the U-235 from U-238, an operation essential for explosive uses of U-235, and probably important for future commercial controlled-chain piles, has been most difficult. Chemical separation was impossible because U-235 and U-238 are chemically the same.

The only possibility was a separation by physical differences, primarily a one percent difference in weight. The porous barrier and centrifugal methods pictured above required vaporizing a salt of uranium. All the methods shown have been used or tried on the Manhattan Project. All require many stages to achieve a substantial concentration of Uranium 235.

Dollarwise Thoughts on Atomic Energy

Costs mean little in war, but peacetime uses of U-235 and plutonium must pass the dollar test in competition with coal, fuel oil, natural gas, gasoline and electricity.

On the basis of energy costs only, *"all other things being equal,"* the table on the last page of this section shows at what price per pound U-235 would give the same energy cost as conventional energy sources selling at the indicated prices. For such comparisons it is convenient to remember that one pound of U-235 is equal (energy-wise) to about 11,400,000 kilowatt-hours, also to 1500 tons of coal, or 200,000 gallons of gasoline.

Fuel engineers understand the limitations of such oversimplified comparisons. Others should be warned that "all other things" are never equal. With this thought in mind, reconsider the uranium piles operated at Hanford to produce plutonium. These use U-235 in the cheapest form, say about $1400 per lb., assuming purified normal uranium at $10 per lb. (140 lb. of uranium contains one pound of U-235.)

If this were the whole story, coal would have to sell for a dollar a ton to break even with U-235 as a water heater. However, the pile using normal uranium must be immense to hold its own in a chain reaction. More important, the accumulating fission products "poison" the reaction after only a small part of the U-235 has been used up. Then the uranium cylinders must be removed for plutonium recovery. Finally, it has not yet been found possible to operate the normal-uranium piles at high enough temperatures for practical power production.

If we go to the other extreme and build a small pile, using concentrated U-235, we shall run into excessive material costs, perhaps several times the $52,000 per lb. set down in the table as the equivalent of 20-cent gasoline.

Something between the two extremes is likely to prove the most economical — perhaps a pile operating on a U-235 concentration between 1 and 10%.

The engineer of the "atomic-power age" must know the price of Uranium 235 *in various concentrations* and the characteristics of piles suited to them. No such information is yet available. He must also watch the danger from radio-activity; the requirements for radiation shields; explosion hazards, etc.

CONTINUED ON NEXT PAGE

WHAT TO EXPECT

Before discussion of possible and probable future applications of atomic energy to the arts of peace, the atomic bombs should have consideration. We may assume that these bombs contained from two to 200 lb. of either U-235 or plutonium, or both. No more precise information is available.

Details of the bomb design have been completely suppressed, but the following basic considerations are stated or implied in the Smyth Report:

The explosive in a bomb must be highly concentrated U-235 or plutonium. Since slow neutrons could not produce a satisfactory explosion, the neutron retarder or *moderator*, is minimized. This, in turn, requires a U-235 mass so large that the escape of neutrons without hitting nuclei will not be excessive. For every 1000 atoms hit, the neutrons produced must split more than 1000 new atoms, so that the reaction will proceed rapidly in an expanding chain, as sketched below.

There can be little leeway in the size of the explosive charge. For a given shape there is a certain "critical" weight of material. If this is exceeded the bomb explodes instantly. If the weight of charge is less than the critical, it cannot be made to explode.

Therefore, the critical mass must be created at the moment of explosion.

The Smyth Report suggests that this can be accomplished by breaking down the charge into two or more well-separated parts, each having less than the critical mass. At the appointed moment these could be brought together within the bomb to create a supercritical mass, which would then explode automatically.

CLAIMS LIKE THESE ARE NOT JUSTIFIED

1. Pretty soon no more coal will be mined except as a raw material for chemical manufacture.

2. In a few years a tiny bit of uranium, built in at the factory, will drive your car for life through an engine no bigger than your fist.

3. All the big central stations will soon be running on atomic power.

4. Cheap atomic energy will enormously reduce the price of power.

Peacetime Applications

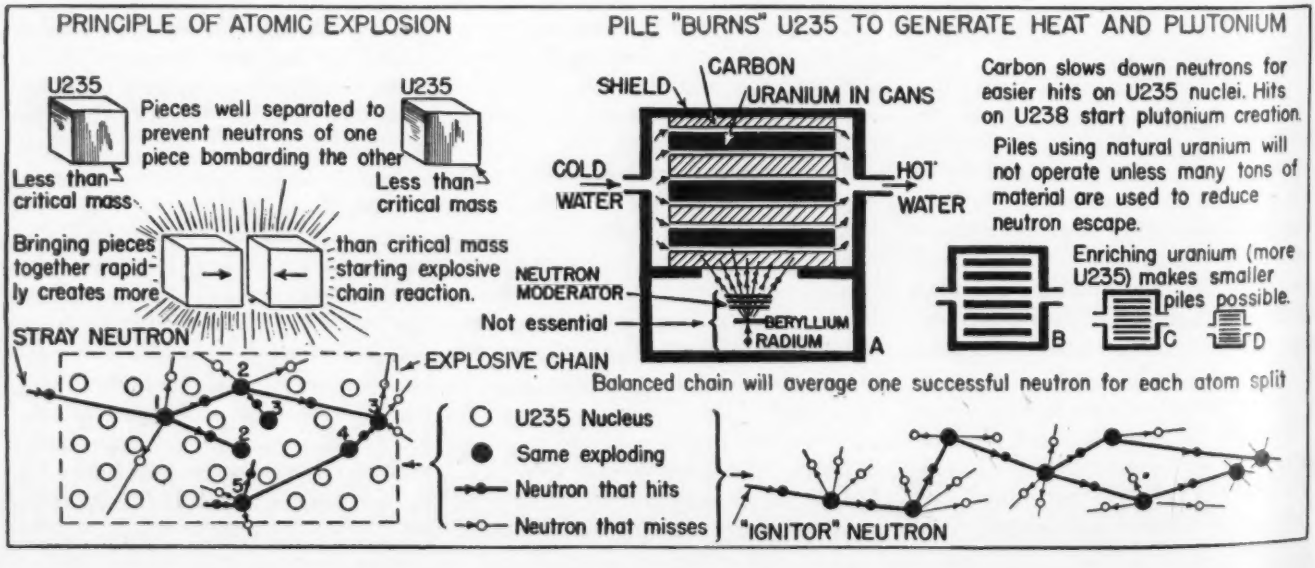
Except possibly for superblasting operations, uncontrolled explosive reactions cannot be permitted in the peacetime use of atomic energy. This means that the quantity of U-235 assembled in any one spot must always be kept well below the critical weight to avoid spontaneous explosion.

Depending on the particular application, the most desirable concentration of U-235 may range anywhere from the 0.7% in normal uranium up to 100%, with the probability that many industrial applications will find the greatest economy in concentrations between 1% and 15%.

This matter of the degree of concentration of U-235 has received little public attention, yet nothing could be of greater practical importance. To make this point clear, consider the two extremes, 0.7% of U-235 and 100% of U-235, respectively.

The Hanford pile, using normal uranium (0.7% U-235) with carbon moderator, must be very large to work at all. It is inefficient in the sense that it must be shut down after a small part of the U-235 has been consumed. It cannot operate at high temperatures.

Its great advantage as a heat producer is the fact that its U-235 is bought at the lowest possible price. If


PRINCIPLE OF ATOMIC EXPLOSION
U235
Pieces well separated to prevent neutrons of one piece bombarding the other
U235
Less than critical mass
Less than critical mass
Bringing pieces together rapidly creates more than critical mass starting explosive chain reaction.
STRAY NEUTRON
EXPLOSIVE CHAIN
PILE "BURNS" U235 TO GENERATE HEAT AND PLUTONIUM
SHIELD
CARBON
URANIUM IN CANS
COLD WATER
HOT WATER
NEUTRON MODERATOR
Not essential
BERYLLIUM
RADIUM
A
Carbon slows down neutrons for easier hits on U235 nuclei. Hits on U238 start plutonium creation.
Piles using natural uranium will not operate unless many tons of material are used to reduce neutron escape.
Enriching uranium (more U235) makes smaller piles possible.
B
C
D
Balanced chain will average one successful neutron for each atom split
U235 Nucleus
Same exploding
Neutron that hits
Neutron that misses
"IGNITOR" NEUTRON

FROM ATOMIC ENERGY

. . . BUT REMEMBER THESE FACTS

1. The large-scale, controlled release of heat energy from U-235 has been fully demonstrated.

2. Beyond question, this energy could be applied directly for heating water and air, and making steam.

3. Such heat, in turn, could be applied directly, or converted into mechanical power or electricity by conventional steam turbines and gas turbines.

4. If and when U-235 in concentrations up to 10% costs less than $25,000 per lb., it may find applications, but will compete, at first, with premium fuels rather than coal.

purified normal uranium sells for, say, $10.00 per lb., the price of 140 lb. (containing one lb. of U-235) will be only $1400. This would be a very favorable price if the pile could operate efficiently with the 0.7% U-235.

Concentrating the U-235 to 100% would permit a much more compact and convenient pile — perhaps little more than small pieces of U-235, encased in aluminum to ward off corrosion, and immersed in a tank of water; this should convert the water into steam at a regulated rate.

In large part, the control would be inherent. The water as a moderator would keep the chain going, but if the reaction got too violent, the resulting higher superheating of the steam would decrease the moderator effect and thereby hold the reaction in check. Yet even if all this comes true the cost of concentrated U-235 in the near future will be many times $10,000 per lb.

Running up the concentration only a few percent above that in normal uranium may prove to be the way to get reasonable pile size and good efficiency without incurring exorbitant concentration costs.

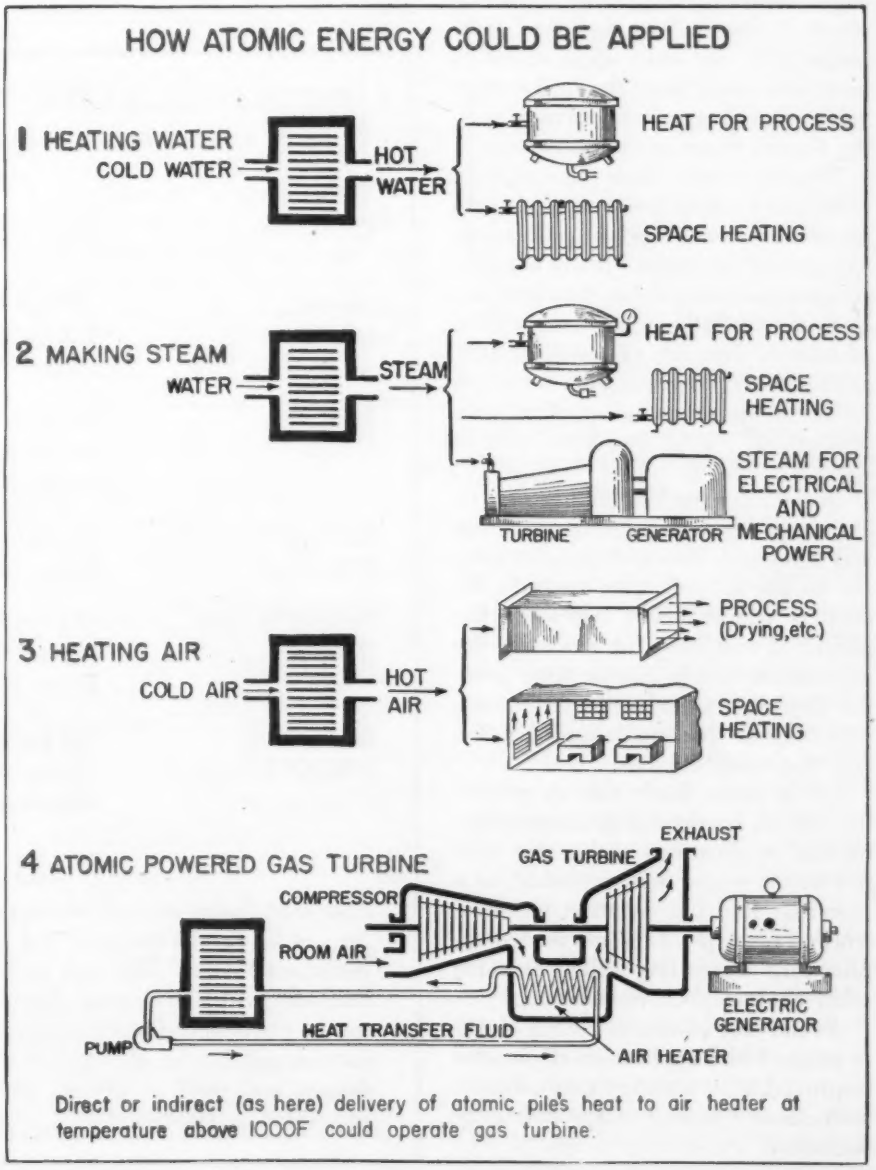
When atomic energy is applied, the starting point is heat, picked up by water, air or a special heat-transfer fluid. Intermediate heat transfer fluids may be essential in certain applications (space heating and service water, for example) where people must be protected from injury by radioactivity.

The intermediate heat-transfer fluid shown for the gas turbine would, of course, have to operate at temperatures up to 1200 F. There seems to be no basic reason why the pile itself could not be built inside the compressed-air receiver, discharging its heat directly to the compressed air.

With rather high concentration of U-235, this arrangement might be suitable for large airplane drive if excessive weight of radiation shields could be avoided.

Also, presumably, rockets and planes of the "buzzbomb" type could be powered by atomic heat delivered to the air of the jet steadily, not in puffs.

The sketches stress direct applica-



Direct or indirect (as here) delivery of atomic pile's heat to air heater at temperature above 1000F could operate gas turbine.

THESE THINGS MIGHT RESTRICT USE OF ATOMIC ENERGY

1. Ineffectiveness of large piles using normal U-235 concentration
2. High cost of concentrated U-235 for smaller, more effective piles
3. Danger from radioactivity
4. Weight and cost of shielding against radiation
5. Explosion hazard
6. Possible short supply of uranium
7. Governmental restrictions on atomic-energy materials

tions of hot air, steam and hot water to process and space heating. This emphasis is justified by the often overlooked fact that such applications of heat have many times the total energy value of all the electricity generated in the United States for all purposes.

There has been much popular speculation regarding the type of engines required for atomic-power generation. The answer is simple. Present engines, steam turbines and gas turbines can be used with little or no change. This, of course, does not rule out the possible discovery of specialized engines for atomic power, or even direct production of electricity from atomic energy.

In the long run the implications of atomic power are staggering for both war and peace. However, popular writers on the subject have undoubtedly created unreasonable hopes in the minds of readers — for example, the expectation that in two or three years the Detroit builders will market cars with built-in "lifetime" slugs of U-235 and "fist-sized" engines.

Yet it seems fairly safe to predict that atomic energy will find some commercial applications within the next five or ten years, first, probably, as a premium fuel like aviation gasoline, worth a fancy price for specialized applications where low weight or some other characteristic is important.

As the cost of concentrating U-235 is reduced and application efficiencies improved, atomic energy may compete with cheaper fuels, perhaps ultimately with coal.

Important non-power applications of atomic energy may well include the ultra-high-temperature processing and fabricating of materials — also, modern "alchemy": building and rebuilding atoms to create new elements and to produce old elements at lower costs.

Radioactivity obtained directly or indirectly from artificial atom-splitting should find many important medical and industrial applications.

Turning back to ordinary power applications, we must avoid the temptation to overstress the economic importance of lower-cost power fuel. Fuel cost is only about 17% of the gross receipts of the electric utilities. Here's another way to put it: If, after allowing for transmission losses, one kilowatt-hour delivered to the consumer from modern plants represents a coal consumption of 1.5 lb., and if the coal costs $5.00 per ton cancellation of the coal bill could not save more than 3/8 of a cent per killowatt-hour. And atomic fuel will certainly not be free.

Performance of the atomic bomb is a monument to the scientists who unlocked the secrets of the atom and suggested the basic technique of making plutonium and concentrating U-235.

From there on, the job was at least 50% engineering. The various big plants of the Manhattan Project are vast assemblages of pipes, tanks, boilers, valves, instruments and controls, installed and operated by engineers, largely designed by engineers. From now on, the speed with which atomic power becomes practical will depend on the effectiveness of the engineer-scientist team.

It is possible, of course, that national controls may completely upset the entire technical and economic pattern of this discussion. For reasons of national security the government may decide to control or restrict atomic-power materials, plants and operations in ways not yet determined.

U-235 COULD COMPETE AT THESE PRICES

other things being equal

Common fuel	*Assumed prices*	*Comparable prices for Uranium 235, dollars per pound (nearest thousand)*
COAL	$6 per ton	$9,000
(13,000 B.t.u.)	$12 per ton	$18,000
	$15 per ton	$23,000
FUEL OIL	2¢ per gal.	$5,000
(150,000 B.t.u. gal.)	4¢ per gal.	$10,000
	8¢ per gal.	$20,000
CITY GAS	50¢ per 1000 cu. ft.	$39,000
(500 B.t.u.)	$1 per 1000 cu. ft.	$78,000
NATURAL GAS	25¢ per 1000 cu. ft.	$10,000
(1000 B.t.u.)	50¢ per 1000 cu. ft.	$20,000
	$1 per 1000 cu. ft.	$40,000
GASOLINE	10¢ per gal.	$26,000
(150,000 B.t.u. gal.)	20¢ per gal.	$52,000
	30¢ per gal.	$78,000

BUT

Note that "other things" are never equal. U-235 in normal uranium form is by far the cheapest, but involves use of excessively large and inefficient "piles." The unit cost of the U-235 in enriched mixtures increases with the degree of enrichment. Over-all cost comparisons can be made only for a specified concentration of U-235 and for apparatus suitable for that particular concentration. Possible explosion danger and need to protect personnel against radiation are other important considerations.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Trailer Mounted Set Speeds Fault Location

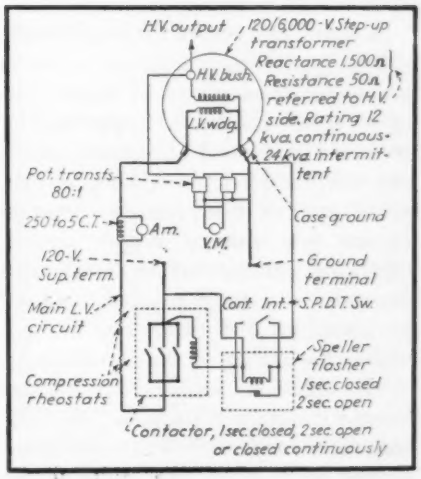
W. D. SEAL

Engineer, Electrical Dept.
Indianapolis Power & Light Co., Indianapolis, Ind.

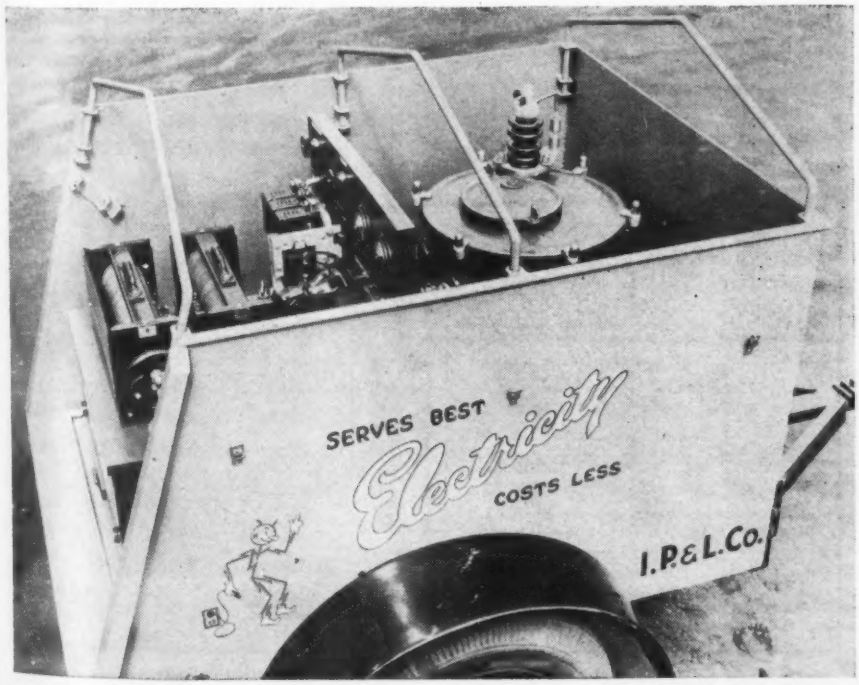
Four years of successful experimentation with cable fault locating equipment culminated recently in the construction of a trailer-mounted fault locating set for use on underground a.c. network feeders of the Indianapolis system. By cutting the time required for finding trouble from as high as two days to less than two hours, this set not only reduces the cost of correcting trouble, but minimizes the danger of customer outages. Cost of the equipment, part of which was salvaged from older equipment, was about $1,120.

Bulk of the 4,175-volt, a.c. network feeders in Indianapolis are 4/0 to 500,000 circ. mil. paper-insulated single-conductor cables. Failures are limited to single line-to-ground faults by ground relays. Most of these faults are of such high resistance that the faulted phase can't be distinguished from others by "megger" tests.

Faults are found, with the set, by applying sufficient a.c. voltage, using a high impedance, step-up transformer to break them down and impress a tracing current of 2 amp. on the faulted cable. Two amperes is a very satisfactory tracing current magnitude; it is easily maintained and has no destructive effect on the cable.



WIRING DIAGRAM of fault locating set

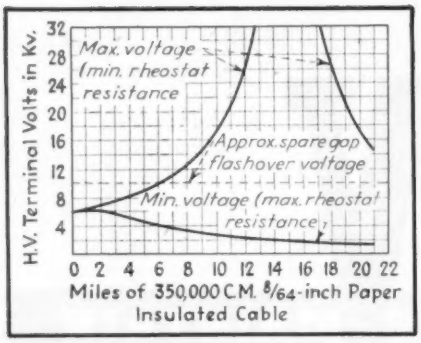


CABLE FAULT LOCATING SET on half-ton trailer spots trouble on a.c. network cables

Practically all our faults break down under test potentials of from zero to 7,000 volts. However, it is immaterial whether or not the fault is reduced to a low resistance. If the fault does carbonize it is traced with a clip-on ammeter having a 10-amp. scale. Since tracing current is intermittent at regular intervals, it can be distinguished easily from stray current.

About 60 percent of our faults do not reduce to low resistance. In these cases, when voltage is raised sufficiently to cause flashover at the fault, the voltmeter reading drops to about 1,600 volts (actual). Cable charging current discharges through the fault every half cycle with a snapping sound. Faults are found by listening at each manhole for this discharge.

Since inductance of the transformer is in series with capacitance of the cable the effect of resonance is used to produce enough terminal voltage to break down any cable fault encountered, even through the required



CURVES SHOW terminal voltage available for breaking down cable faults in various lengths of 350,000-circ. mil. paper-insulated cable

voltage is higher than the 6,000-volts, open circuit voltage.

A spark gap across the single high-voltage transformer terminal prevents accidental development of excess voltages from conditions approaching resonance. Control of voltage before and current after breakdown is provided by two compression rheostats in the low voltage supply circuit. Charging current before breakdown depends on voltage required and capacitance of the cable but is well within the rating of the transformer.

The 120-volt supply to the fault locator is obtained from the 120/208-volt, secondary bus in a network transformer vault where the faulty feeder is terminated. An automatic contactor in the low-voltage supply circuit is timed to operate in cycles of one second closed; two seconds open. This contactor serves two purposes. These are:

1. By reducing the duty cycle of the transformer it increases safe current-carrying capacity from 2 amp. to 4 amp. on the high-voltage side.
2. It provides an intermittent tracing current easily distinguishable.

A Sangamo speller-flasher is used to control the operation of this contactor. A single-pole, double-throw knife switch is used in conjunction with the speller-flasher to close the contactor continuously or intermittently.

The wiring diagram of the fault locator and curves showing the range of voltage available for breaking down faults are included herewith. For convenience in interpreting the curves, the high-voltage terminal voltage is plotted against miles of 350,000-circ. mil., 8/64-in., paper-insulated cable rather than against capacitive reactance. The conversion of capacitive reactance to miles of cable is based on a calculated capacitance of 1.14 microfarads per-mile per-phase to sheath. For this capacitance the capacitive reactance of the cable is 2,330 ohm-miles.

• • •

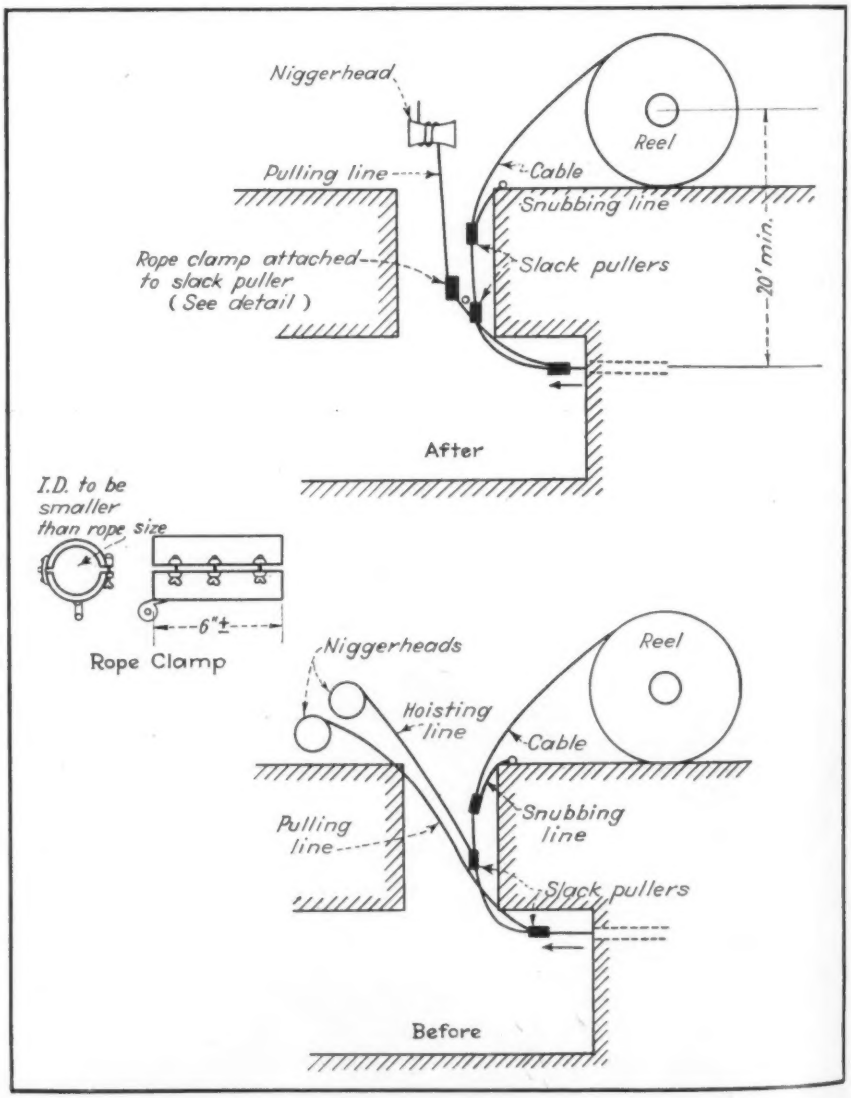
Pull-Hoist Cable with Less Effort

Accompanying sketches illustrate a change that has been made in the method used in pulling cable from underground ducts on the Detroit Edison Co. system and which has resulted in considerable saving in time and labor.

As shown in the "before" sketch two lines were formerly used; one to pull the cable from the duct and the other to hoist the slack through the manhole mouth to the cable reel. This scheme required close coordination and elaborate signaling between men in the manhole adjusting the "slack pullers" and operators of the two winches required. Also, there was a certain element of hazard involved for the men in the manhole should the hoisting line slack off and allow the slack cable to run off the reel into the manhole.

By suggestion from the field, a rope clamp was devised which now permits a single pull line to be used for both pulling and hoisting the cable. This arrangement has the advantage that a single winch can be used, permitting the "niggerhead" on the truck winch to be spotted directly over the manhole. Since only a single niggerhead is required the job can be done with fewer men and less confusion.

To make a pull with this method



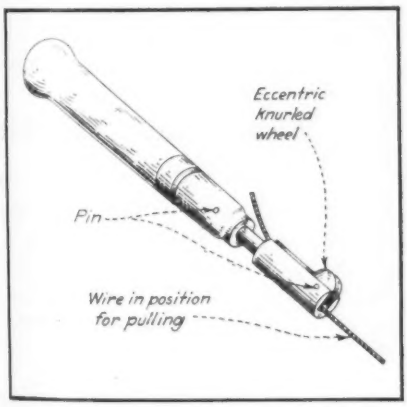
PULL AND HOIST CABLE from manhole ducts with single line. Procedure requires fewer men, less time and equipment than previous two-line method

the man tending the snubbing line allows the cable to run through his slack puller as the cable is pulled and hoisted by the main line. The snubbing line then holds the cable while pulling and hoisting slack pullers are slid back along the cable for a new "bite." This procedure is repeated with the snubbing line alternately sliding and holding the cable as pulls are made and the slack pullers reset until the cable section has been completely removed from the duct.

•

Wire Puller Has Slip-Proof Feature

An easily constructed wire puller has improved the method of tightening locking wires. The puller is easier to handle and much safer than the conventional method, tightening wire with pliers, especially for women who are now doing the job. It was devised by Carl Schreck of General Electric's Schenectady Works Regulator Division.



WIRE PULLER has eccentric knurled wheel to tighten wire grip

A knurled, eccentric wheel $\frac{1}{8}$ in. thick and $\frac{1}{2}$ in. in diameter is the secret of the new device. It is mounted in a piece of drill-rod with a milled slot to accommodate both the wire and wheel. The wire is threaded into the slot and under the wheel which is then rolled back toward the handle to apply pressure on the wire. The grip on the wire is automatically increased as the operator pulls the tool to tighten the wire.

The drill-rod is approximately $2\frac{1}{2}$ in. long of $\frac{1}{2}$-in. stock. The shank end, however, is turned to a $\frac{1}{4}$-in. diameter and is fitted and pinned in a wooden handle. The pin, knurled wheel, and rod should all be hardened.

Breaker Operating Panel for Maintenance Shop

For testing the operating mechanism of removable 33-kv. metal-clad oil circuit breakers during periodic maintenance operations at Marktown substation, Northern Indiana Public

BREAKERS undergoing maintenance can be tripped and closed at will from this operating panel provided in the substation shop. The cable connects with control cable fitting on the breaker

Service Co. has equipped the local shop with a control panel, shown, from which the breaker can be closed or tripped by its own mechanism instead of by hand. The breakers are large enough so that repeated manual operation is hard work.

On the panel, in addition to a main line switch and breaker operating handle with indicating lights, are two ammeters; one indicating breaker tripping current, the other closing current drawn by the breaker control mechanism. A multi-conductor, rubber-covered cable connects the panel with the breaker's control cable fitting.

During maintenance operations the metal-clad breakers, located outdoors, are lowered and brought into the shop on an electrically powered combination transfer car and elevator which travels on rails between the substation and shop. A socket is also provided on the control panel for supplying power to the elevator motor on this transfer car while it is in the shop.

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Street Light Data Supplied by Police

Policemen at Pitcairn, Pa., report street light outages to the operator at the municipal plant. This information was formerly jotted down on any scrap of paper available at the moment and consequently no semblance of order resulted.

To do away with this condition, O. W. Bendorf, chief engineer, devised the illustrated $8\frac{1}{2}$ by 14-in. form which is kept handy on the operator's desk. Spaces are provided for the following information:

1. Date reported
2. Number of lamp
3. Location of lamp
4. Size
5. Date replaced.
6. Remarks

When the 44 spaces are filled the form is filed so that checks are available on lamp life or any unusual conditions which appear in the "Remarks" column.

LAMPS

Date	No.	Reported	Location	Size	Replaced	Remarks

Recap; ( )-250. ( )-150. ( )-100. ( )-60. ( )-25

FORM FOR TABULATION of non-burning street lamps from information supplied by police. Three columns at right are filled in by trouble man upon replacement. Inventory of all lamps kept at bottom

Restoring Flashlight Cells for Metermen

ULRICH S. FISHER

Laboratory Technician, Western Massachusetts Electric Co., Springfield, Mass.

To restore spent size-D flashlight cells in overcoming the present battery shortage, the counter e.m.f. method is utilized to obtain about 85 percent saving in cell usage, following a definite program. The Western Massachusetts Electric Co. has developed a testing and charging outfit for this purpose, shown herewith, which is used by meter readers without requiring other attendance. It includes a supply source, copper oxide rectifier, mil-ammeter and voltmeter, control rheostat and cell bank holder with connections as reproduced (Fig. 1), a close-up of the cell bank holder being shown (Fig. 2).

The cell bank holder contains 18 tubes, each carrying four dry cells in series. The tubes are each of 1.25-in. pipe, 10.5 in. long. One tube is provided for each meter reader and installer, plus five spares. The tubes are cut away in halves at each end to accommodate cell handling. Flexible contacts are provided at the top of the tubes and stationary ones at the bottom, with connections to copper buses attached to hardwood strips to take a d.c. supply. The cell bank holder is mounted at a 30-deg. angle so that when restored cells are removed from the base of the tube, the upper cells will slide into place by gravity.

In starting operations the tubes are filled with fresh cells set in series with their bases on the stationary or lower contacts. The mil-ammeter jack is inserted at the tube bases to find a cell giving approximately zero meter deflection; the bus bar switch is closed and control rheostat adjusted to give a positive reading of 4 m.a. The restoring current is allowed to run about an hour. Each tube is then checked individually, when the readings should agree within 10 percent, unless trouble exists in the resistor of the bank in question or a poor cell is present. When the restorer is functioning properly each meter reader and installer is assigned a tube and two or three fresh cells for his torch. Daily he removes the restored cells from his tube, inserting spent cells at the top. This insures a steady supply and prevents draining cells below the restoring point, which happens so often in domestic use. A rest period for cells is needless, as the device causes the current to taper off automatically as the e.m.f. rises. The mil-ammeter will show a deflection of 0 to 2 when inserted in a tube of fully restored cells, and 10 to 12 m.a. for a tube of newly loaded spent cells. An important accessory is a battery checking d.c. voltmeter with scale marked "Red, Discard," from 0 to 0.9 volts; "White, Charge," 0.9 to 1.45 volts; and "Black, O.K.," 1.45 to 2 volts. Readings are made through a 4-ohm resistor with a 2-volt voltmeter. A low-resistance voltmeter may be used if rated at not below 50 ohms per volt.

The proper lamps to use in such torches are "PR6," 2.5-volt, or "PR7," 3.8-volt ratings.

It is estimated that about 100 minutes of flashlight service are required per average 8-hr. day, giving an energy consumption of 37.5 watt-minutes for a 2-cell torch. Seventy-two size "D" cells restored will deliver 2,690 watt-minutes of energy over an 8-hr. period, whereas only 2,160 watt-minutes were required to charge these cells, a gain of about 24 percent. Assuming a cost of 5 cents per kilowatt-hour, the cost of restoring 72 size "D" cells is about 0.0015 cents. This device has been in use on this system one year, and the cell life has been increased by 15 times on the average, compared with no recharging.

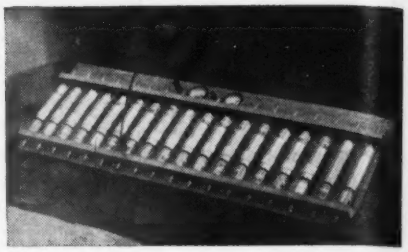


FIG. 2—Tube and cell holder unit, showing bank of 18 tubes holding 4 cells each, with testing instruments. The transformer and rectifier for supplying low voltage direct current are mounted below the base plate. Controls are in the upper center of the unit

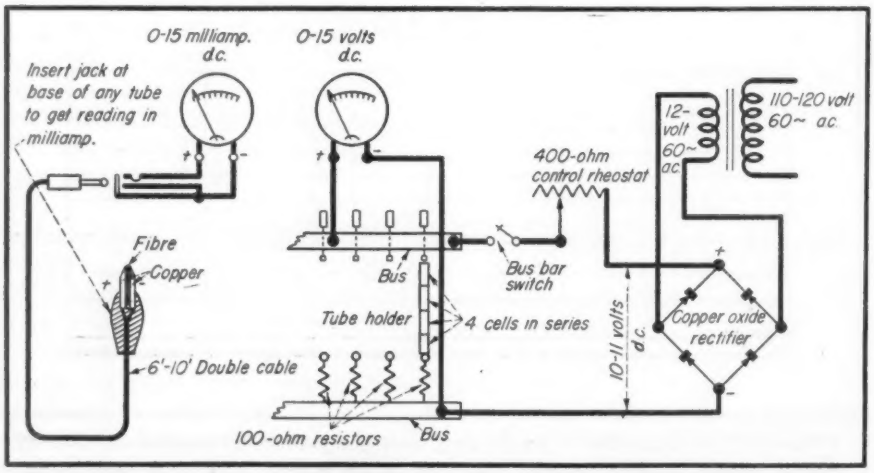
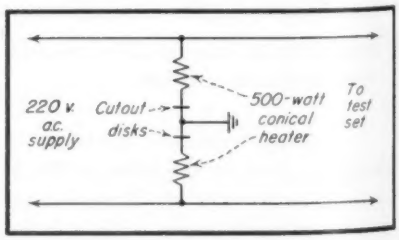


FIG. 1—Wiring diagram of charging equipment used in restoration of cells

Surge Protector for High Voltage Test Set

Protection of control equipment on high-voltage (33/66 kv., 50 kva.) test sets against burnouts caused by surges has been successfully provided on the units of the Philadelphia Electric Co. This has been done by connecting a non-inductive resistance to ground across the control circuit on the line side.



HIGH-VOLTAGE test-set control equipment protected by two 500-watt conical heaters and cutout disks in a two-pole plug-fuse cutout connected as shown

This "surge protector" consists of two conical-shaped heater units having a rating of 500 watts at 115 volts. These are screwed into a standard 2-pole plug-fuse cutout so connected that each resistance is in a line-to-ground circuit. A film cutout disk is

LIMITAMP control, for use with squirrel-cage, synchronous, and wound-rotor motors, has an interrupting capacity more than adequate for installation on most industrial power circuits.

Plant Equipment Protection—The Type EJ-2 fuses in this control give your electric equipment the fast, positive, short-circuit protection so necessary for safe operation on high voltages. They operate in a split cycle. When a short occurs, they cut off the rise in current in less than a quarter cycle, and clear it in less than a half cycle—long before the short-circuit current has had time to harm the contactors or motor.

Personnel Protection—Totally metal-enclosed controllers give protection to operating personnel. High-voltage circuits are completely segregated. All high-voltage equipment is mounted in the upper and rear compartments, and all low-voltage equipment is mounted in the front compartment.

—and contactors good for years of constant, repetitive service. The full short never passes through the contactors. Therefore, the contactors, which are air-break, are designed to meet the most severe requirements of high-voltage motor-control service. Mechanical life of several million operations, and contact-tip life many times the life of comparable oil-immersed tips, make these air-break contactors the logical answer for any severe duty—in steel mills, rubber mills, etc.

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all about this motor control. How a group of these starters can be fitted together to give you a neat, compact control panel. Our local sales engineers will be glad to help you select a control to fit your application. *General Electric Co., Schenectady 5, N. Y.*

placed in the socket at the base of each resistance unit. These disks are rated at 250 volts breakdown.

When a surge develops, it will puncture the disk and "go to ground" before reaching sufficient magnitude to damage the motor, the magnetic break or the relay coils.

The original protector was made by James S. Snyder of the Testing Section, Engineering Dept. Use of the protector for more than one year has eliminated all damage to motors, magnetic brakes, and relays.

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Oral Tests in Lineman Training—II*

C. T. MALLOY
General Superintendent
Transmission, Distribution and Communication
Southern California Edison Co., Ltd.
Los Angeles

As a guide for apprentice linemen and a review for older employees on transmission line work, the following questions have been selected from a questionnaire given to apprentice patrolmen and second class linemen prior to their starting the third period of training.

1. A. What advantage does the pole-top method of artificial respiration have over the Schafer method?
   B. How long since you have practiced each method?
2. A. Have you had experience enough that you feel you are adept in climbing poles and towers?
   B. Should the climbers be used where the pole is stepped?
3. A. Describe the standard side and top ties used on insulators on communication circuits.
   B. What is the proper working position (in relation to the wires being worked on) for working on communication conductors?
4. A. How often are transmission circuits patrolled?
   B. What is to be checked when patrolling lines?
5. A. How many tucks of each strand are necessary to furnish the strength of the rope in a splice?
   B. Why is a long splice used instead of a short splice?
6. A. Who must be notified when there is a serious accident?
   B. How can arrangements be made for calling if you are to be away from home during "on call" hours?
7. A. What are the most important factors to be considered in splicing conductors?
   B. Why is vaseline or Calol grease used in making splices in transmission conductors?
8. A. How should rubber protective equipment be stored on the truck?
   B. When should rubber protective equipment be used?
   C. What wires should be protected by rubber?
9. A. When is it necessary to use a safety belt?
   B. Is it safe to attach a safety belt above the top arm on a pole?
   C. Name several conditions that are common to a safety belt when it is unsafe for further use?
10. A. Why are trees trimmed to keep the wires clear?
    B. What procedure is necessary before trees are trimmed?
    C. Is there any reason to shape a tree in addition to just cutting the limbs that may contact the wires? If so, why?
11. A. What does "getting in series with a circuit" mean?
    B. What does "accidentally grounding a circuit" mean?
    C. What does it mean to "short" a circuit?
    D. What does an "open circuit" mean?
12. A. How is a "clearance" to work on a circuit secured?
    B. What precautionary steps are taken to prove a circuit "dead" after a "clearance" is had on that circuit?
    C. Why are shorts and grounds installed on a de-energized circuit before working on the line?
    D. Name the common hazards involved when installing and removing a short and ground from a "dead" circuit.

* Second of a four-article series which began in ELECTRICAL WORLD, August 18, 1945.

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Induction Telemetered for Identification

T. W. ALEXANDER, *Asst. Engineer, The Bell Telephone Co. of Pennsylvania, Pittsburgh,* and T. L. PADEN, *Superintendent of Operation, Pennsylvania Power Co., New Castle*

Identification of the source of noise in a number of open wire telephone circuits which paralleled a 22-kv. power circuit was facilitated by observation of a millivolt meter placed at a convenient but distant point.

During a study of this situation by the power and telephone companies, T.I.F. measurements were made on the power system at a nearby substation and it was found that the T.I.F. was quite high (200) for periods of 15 minutes to an hour or more and then would drop off to 40 or 50 for like periods. It was also found that the noise on the telephone circuits increased and diminished in step with the rise and fall of the T.I.F. on the power circuit.

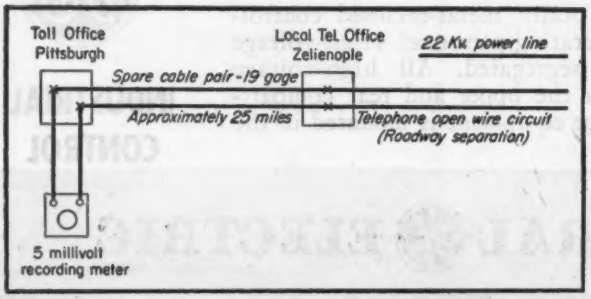
It was desirable to have a series of 24-hour charts of these periodic variations in the noise and T.I.F. in order to study them and, if possible, associate the variations with the operating periods of some power equipment connected to the power system. However, the location where this high T.I.F. and noise were apparent, Zelienople, was at a considerable distance from either the power or telephone company headquarters, and neither company had personnel at the scene of the exposure who could conveniently attend to a recording meter and prepare the charts.

In order to obtain these charts without making a daily trip from headquarters, one of the noisy telephone circuits was connected to a spare cable pair in a toll cable extending from Zelienople to the Pittsburgh toll office. This cable pair was then connected to a 5-millivolt recording meter at the toll office and a record of the variations in noise was obtained. No attempt was made to calibrate the recording meter to read noise units or decibels since the interest was in the periodic variation and not in the absolute value of the noise.

As a result of the charts obtained in this manner, it was finally determined that the cause of the high T.I.F. was a 3,500-h.p. synchronous motor in a steel mill approximately ten miles from the section of parallel between the power and telephone lines.

The distance over which these signals were transmitted was approximately 25 miles. However, there is no reason why this distance could not be extended through the use of suitable equipment, including amplifiers. Also, in other cases, it might be necessary to use noise-weighing networks and different recording instruments. It should also be mentioned that this method of making noise measurements at a point remote from the source has been used in other instances.

MILLIVOLT METER registers characteristic telephone induction caused by large synchronous motor 25 miles away



...ave won wide acceptance

1. These ultramodern, dry-type distribution transformers are designed to meet AIEE Standards No. 1 for Class B insulation, with 130 C maximum hot-spot temperature in a maximum ambient of 40 C. They also meet ASA Standards C-57.1, which limit the observable temperature rise to 80 C.

2. Because they meet industry standards for hot-spot temperature, G-E dry-type transformers are better suited to handle emergency overloads than units designed to higher temperatures. Longer life under severe service conditions is the inevitable result.

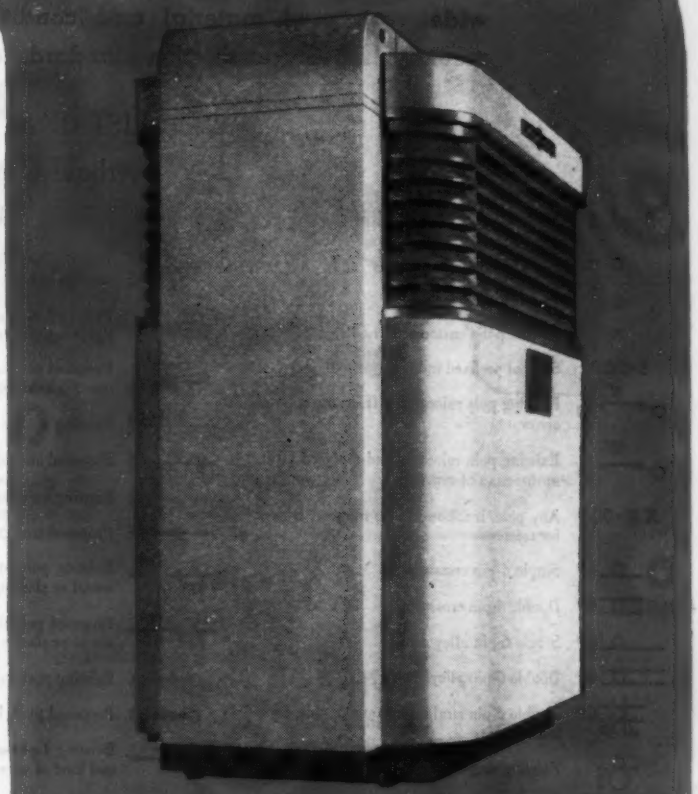
3. Housings are designed for utility, and are attractive in appearance.

4. Completely metal-enclosed construction prevents rods and wires from being accidentally pushed into the live parts.

5. There are no exposed live parts, such as bushings, that would lessen safety and make a fence mandatory.

6. Cable terminal compartments are completely removable, so the high-voltage and low-voltage cables can be made up and the unit slid into place between them without the use of a crane or elaborate hoisting and jacking facilities.

7. Transformer side plates are readily removable to facilitate inspection and cleaning of the core and coils.



Styled dry-type G-E distribution transformers are available for use on 601- to 15,000-volt primary circuits, in ratings from 100 to 2000 kva.

If you prefer dry-type designs, you will find these ultramodern dry-type transformers ideal for modernizing your plant's power system.

Their trim good looks, their safety, and ease of installation make dry-type units "at home" anywhere in your plant.

They fit right in with the economic good sense of *load-center power distribution*, which offers savings in installation cost, power, and assurance of full voltage at every lamp and machine.

When these transformers are a part of unit substations, the interrupting capacity of the substation switchgear section is exactly matched (electrically, mechanically, thermally) with the transformer capacity. It is adequate for even the most severe short circuits.

Ask for Bulletin GEA-3592A (load-center unit substations); Bulletin GEA-3714B (dry-type distribution transformers). *General Electric Company, Schenectady 5, N. Y.*

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HANDY SYMBOLS FOR LINE DEPARTMENT

Symbols for overhead, underground and street lighting facilities embrace a wide variety of material and conditions. The listing is adapted from recently issued construction standards of Hartford (Conn.) Electric Light Co.

LIST OF SYMBOLS

Overhead Construction

Symbol	Description
○	Existing pole
●	Proposed pole
X	Private pole, customer owned
S-000	Symbol prefixed indicates custodian
6'	Existing pole relocated 6 ft. in direction of arrow
10'	Existing pole relocated and replaced 10 ft. in direction of arrow
X H-000	Any pole, if followed by a number, is used for reference
4P	Single 4-pin crossarm
4P	Double 4-pin crossarm
6P	Single 6-pin alley arm
6P	Double 6-pin alley arm
6P 4P	Double 6-pin straight line and double 4-pin buck arms
5	Existing single transformer 5 kva.
② 5/7½	Existing two transformers, one 5 kva. and one 7½ kva.
5	Proposed single transformer 5 kva. with lightning arresters
5/7½	Proposed two transformers, one 5 kva. and one 7½ kva. with lightning arresters
6 M L-19'	Existing anchor and guy
6 M L-19'	Proposed anchor and guy
6 M Tr.	Existing tree guy
6 M Tr.	Proposed tree guy
6 M Hor. P6	Existing pole to pole guy. Designate horizontal or slanting
6 M Hor. P6	Proposed pole to pole guy. Designate horizontal or slanting
PB	Existing push brace
PB	Proposed push brace
#4 Tr.	Existing 1-phase OH primary showing size and kind of wire
#4 TBWP.	Ditto 2-phase
#4 ACu.W.	Ditto 3-phase
#4 Tr.	Proposed 1-phase OH primary showing size and kind of wire
#4 TBWP	Ditto 2-phase
#4 ACu.W.	Ditto 3-phase
3-#4 MHD	Existing OH secondary or service showing number, size, and kind of wire
3-#4 MHD	Proposed OH secondary or service showing number, size and kind of wire
	Capacitor
	Links closed
	Links open
	Neutral ground
	Lightning arrester ground
	Line fuses closed
	Line fuses open

Underground Construction

11 KV-3Φ-350M	Feeder showing voltage, phases and size
ΦA-1/0	Primary mains showing phases and size
ΦA #4	Secondaries showing phases and size
	Oil switch
	Disconnecting pothead
	2-way oil switch open
	3-way oil switch closed
	UG secondary tie box

Street Lighting

○	1500 cp. bracket
◑	1500 cp. ornamental
○	1000 cp. bracket
ⓘ	1000 cp. ornamental
Ⓢ	1000 cp. sodium bracket
◑	1000 cp. semi-ornamental
●	600 cp. bracket
⊗	600 cp. ornamental
▲	250 cp. bracket
△	100 cp. bracket
•	60 cp. bracket
■	400 cp. bracket
2-#6 TBWP	OH street light wire showing number, size, and kind
#6-1/32 P+1/32 L	UG street light cable showing size and kind
	Note: Private lights are circumscribed thus and marked with customer's name
	Lights connected with a broken line are UG lights, all others are OH lights

ABBREVIATIONS

Al	Aluminum	L	Lead or horizontal distance from pole to anchor	PG	Pole guy	SP	Steel pin
Cd	Cedar pole, butt treated	M	1000 lb.	Pn	Pine pole, creosoted	St	Steel wire
Cu W	Copper weld	MHD	Medium hard drawn	Rl	Relocate	Str	Stranded
DA	Double arm	N	Native pole, untreated	Rm	Remove	TBWP	Triple braid weather proof
DT	Double thimble	OH	Overhead	Rp	Replace	Tr	Tree
Jt.	Joint	P-7.5'	At angles indicates "Pull"	RTDT	Rolled thread double thimble	UG	Underground
K	Chestnut pole, tank treated	PB	Push brace	S	Solid	VC	Vertical corner
Kn	Chestnut pole, butt brush treated						

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HOW TO DETERMINE STEAM REQUIREMENTS FOR TURBINE-GENERATOR UNITS

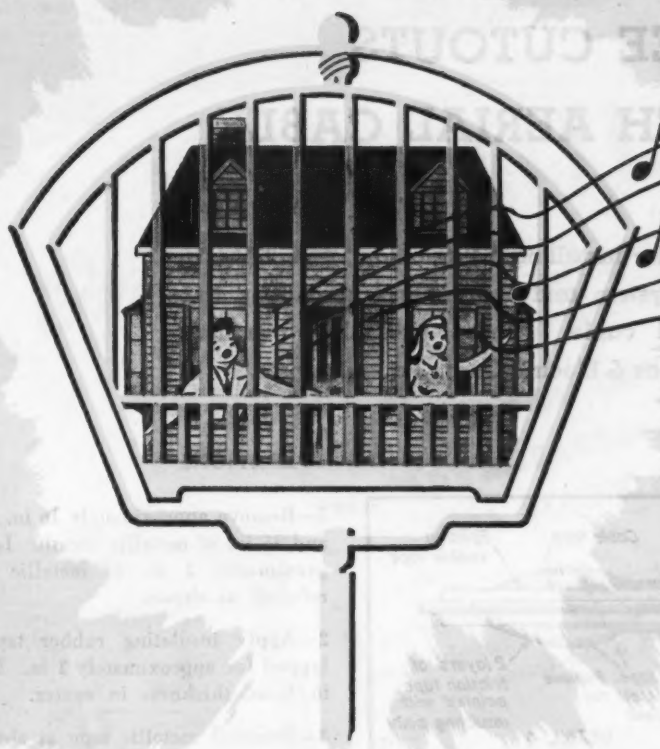
By F. K. FISHER and J. R. CARLSON, Central Station Steam Engineering,
Westinghouse Electric Corp., South Philadelphia, Pa.

Approximate steam consumption, at rated load, is provided in the accompanying tables covering turbine-generator units for capacities 10,000 to 15,000 kw. air-cooled, 20,000 to 50,000 kw. hydrogen-cooled, and for two general classes of initial steam conditions. Straight condensing and closely approximate feed-water heating data are listed for three common conditions of vacuum operation. Similar tables for higher steam conditions—850 lb. gage, 900 deg. F., and 1250 lb. gage, 950 deg. F.—will be published in two subsequent issues of "Electrical World"

Approximate Steam Consumption for Turbine-Generator Units

(At Rated Load and at Various Steam Conditions)

Rating, kw.	No. Stages Feed-Water Heating	1.0 in. Hg. Exhaust Pressure					1.5 in. Hg. Exhaust Pressure					2.0 in. Hg. Exhaust Pressure				
		Rated Load Steam Rate, lb./kw.-hr.	Final Feed-Water Temp., deg.F.	Steam to Turbine, 1,000 lb./hr.	Heat Rate, Btu./kw.-hr.	Steam to Condenser, 1,000 lb./hr.	Rated Load Steam Rate, lb./kw.-hr.	Final Feed-Water Temp., deg. F.	Steam to Turbine, 1,000 lb./hr.	Heat Rate, Btu./kw.-hr.	Steam to Condenser, 1,000 lb./hr.	Rated Load Steam Rate, lb./kw.-hr.	Final Feed-Water Temp., deg.F.	Steam to Turbine, 1,000 lb./hr.	Heat Rate, Btu./kw.-hr.	Steam to Condenser 1,000 lb./hr.
Steam Conditions: 400-lb. Gage, 750 deg. F.																
Single Casing Units																
10,000	0	9.03	79.0	90.3	12,120	90.3	9.30	91.7	93.0	12,360	93.0	9.52	101.1	95.2	12,570	95.2
	2		283	98.2	11,170	80.7		296	101.6	11,410	83.5		305	104.4	11,620	85.8
	3		315	100.0	11,040	79.4		328	103.6	11,290	82.3		337	106.4	11,490	84.5
	4		333	100.8	10,940	78.4		346	104.5	11,190	81.3		355	107.4	11,400	83.6
15,000	0	9.02	79.0	135.3	12,100	135.3	9.21	91.7	138.2	12,240	138.2	9.39	101.1	140.9	12,390	140.9
	2		283	147.2	11,150	121.0		296	150.8	11,300	124.0		305	154.3	11,460	126.8
	3		315	149.9	11,030	119.0		328	153.7	11,180	122.0		337	157.3	11,340	124.9
	4		333	151.1	10,930	117.6		346	155.1	11,080	120.7		355	158.8	11,240	123.5
20,000	0	8.95	79.0	179.0	12,010	179.0	9.12	91.7	182.4	12,120	182.4	9.28	101.1	185.6	12,250	185.6
	2		283	194.7	11,070	156.0		296	199.1	11,190	163.7		305	203.3	11,320	167.1
	3		315	198.3	10,950	157.5		328	203.0	11,070	161.1		337	207.3	11,200	164.6
	4		333	199.9	10,850	155.5		346	204.7	10,970	159.3		355	209.2	11,110	162.8
Steam Conditions: 600-lb. Gage, 825 deg. F.																
Single Casing Units																
10,000	0	8.41	79.0	84.1	11,550	84.1	8.62	91.7	86.2	11,730	86.2	8.79	101.1	87.9	11,880	87.9
	2		307	92.4	10,570	74.2		320	95.1	10,760	76.4		329	97.4	10,920	78.2
	3		335	93.6	10,430	72.8		348	96.4	10,620	75.0		357	98.7	10,780	76.8
	4		351	94.2	10,340	72.0		364	97.0	10,530	74.1		373	99.4	10,680	75.9
15,000	0	8.32	79.0	124.8	11,430	124.8	8.49	91.7	127.4	11,560	127.4	8.63	101.1	129.5	11,670	129.8
	2		307	137.2	10,460	110.1		320	140.6	10,600	112.9		329	143.4	10,720	115.1
	3		335	138.9	10,320	108.0		348	142.4	10,460	110.8		357	145.4	10,580	113.1
	4		351	139.7	10,230	106.7		364	143.4	10,370	109.5		373	146.4	10,490	111.8
20,000	0	8.21	79.0	164.2	11,280	164.2	8.36	91.7	167.2	11,388	167.2	8.50	101.1	170.0	11,490	170.0
	2		307	180.5	10,320	144.9		320	184.5	10,430	148.2		329	188.3	10,560	151.3
	3		335	182.7	10,190	142.2		348	186.9	10,300	145.4		357	190.9	10,420	148.5
	4		351	183.8	10,090	140.4		364	188.1	10,200	143.6		373	192.2	10,330	146.8
25,000	0	8.20	79.0	205.0	11,260	205.0	8.33	91.7	208.0	11,340	208.0	8.46	101.1	211.5	11,440	211.5
	2		307	225.3	10,310	180.9		320	229.6	10,390	184.3		329	234.3	10,500	188.1
	3		335	228.1	10,170	177.5		348	232.6	10,260	180.9		357	237.4	10,370	184.7
	4		351	229.4	10,080	175.2		364	234.1	10,170	178.9		373	239.2	10,280	182.7
Tandem Compound Units																
30,000	0	8.16	79.0	245.4	11,210	245.4	8.28	91.7	248.4	11,270	248.4	8.40	101.1	252.0	11,350	252.0
	3		335	272.4	10,120	211.9		348	277.8	10,200	216.1		357	283.0	10,300	220.1
	4		351	274.0	10,030	209.4		364	279.6	10,110	213.6		373	285.0	10,210	217.7
	5		363	276.0	9,990	207.5		376	281.7	10,060	211.8		385	287.1	10,160	215.9
35,000	0	8.15	79.0	285.3	11,190	285.3	8.27	91.7	289.5	11,260	289.5	8.39	101.1	293.7	11,340	293.7
	3		335	317.4	10,110	246.9		348	323.7	10,190	251.8		357	329.7	10,280	256.8
	4		351	319.3	10,020	243.9		364	325.8	10,100	248.9		373	332.1	10,200	253.7
	5		363	321.9	9,970	242.1		376	328.2	10,050	246.8		385	334.6	10,150	251.6
40,000	0	8.14	79.0	325.6	11,180	325.6	8.26	91.7	330.4	11,240	330.4	8.38	101.1	335.2	11,330	335.2
	3		335	362.3	10,100	281.9		348	369.4	10,180	287.4		357	376.4	10,270	292.8
	4		351	364.5	10,010	278.5		364	371.9	10,090	284.1		373	379.0	10,180	289.6
	5		363	367.4	9,960	276.3		376	374.6	10,040	281.7		385	382.0	10,140	287.3
50,000	0	8.14	79.0	407.0	11,180	407.0	8.26	91.7	413.0	11,240	413.0	8.38	101.1	419.0	11,330	419.0
	3		335	452.9	10,100	352.4		348	461.8	10,180	359.3		357	470.5	10,270	366.0
	4		351	455.7	10,010	348.2		364	464.9	10,090	355.2		373	473.8	10,180	362.0
	5		363	459.3	9,960	345.4		376	468.3	10,040	352.2		385	477.8	10,140	359.3



Only a Bird in a Gilded Cage

Unless they're counselled wisely, far too many home builders, sooner or later, will find themselves in gilded cages. Beautiful to look at but miserably disappointing because of a basic functional shortcoming. Here's what we mean—

People who build now or in the near future should provide for reserve electrical capacity to take care of the many appliances they'll want in the days and years ahead. Air-conditioning units, all-electric kitchens, deep-freeze cabinets, television, motor-powered work shops—eventually, they're going to want such electrical servants in their homes. If they do it later, they'll have a major and costly re-wiring job on their hands.

Utilities derive direct benefits by encouraging full comfort wiring with spare circuits, combined with Multi-breaker convenience and protection. It's a very definite way of reducing service interruptions and costly service calls. It builds valuable customer good will.

The MULTI-BREAKER *eliminates fuses completely. When a short circuit or dangerous overload occurs, the circuit is cut off automatically. A simple movement of the lever restores current after the cause of the overload has been removed. There are no delays—nothing to replace.*

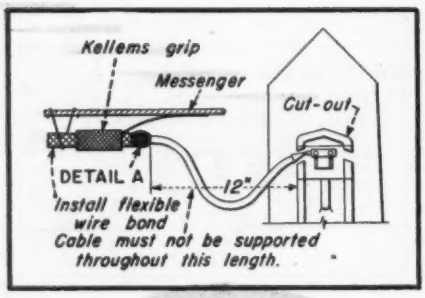
SQUARE D COMPANY

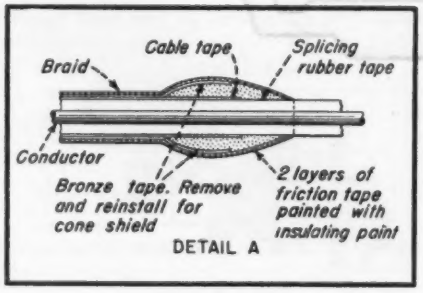
DETROIT • MILWAUKEE • LOS ANGELES

THREE CUTOUTS USED WITH AERIAL CABLE

Methods are illustrated for installing a line cutout, a sectionalizing cutout on a "Y" system and for making a single-phase tap on primary aerial cable. These exemplify practices of the Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.

1—LINE CUTOUT





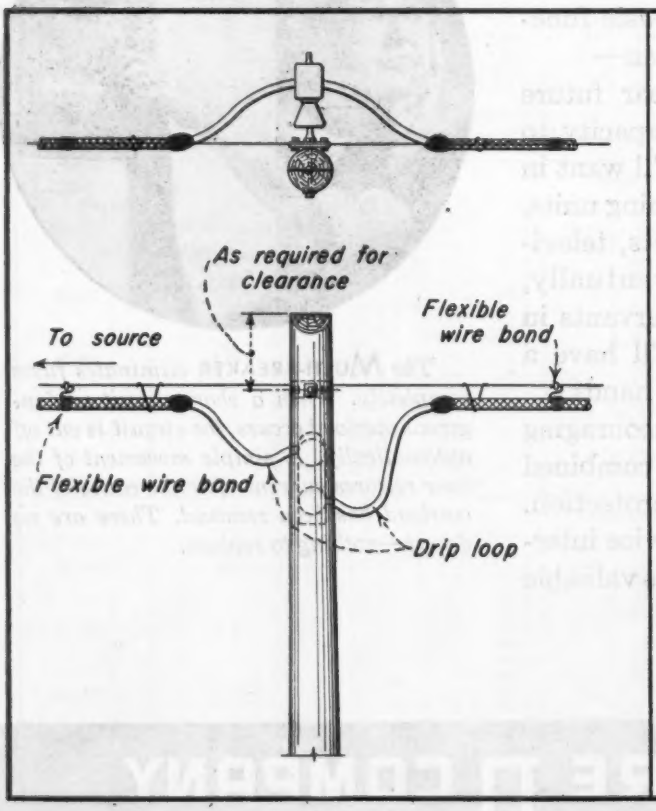
OPERATIONS

1—Remove approximately 16 in. of braid and 15 in. of metallic sheath. Leave approximately 2 in. of metallic tape to reinstall as shown.

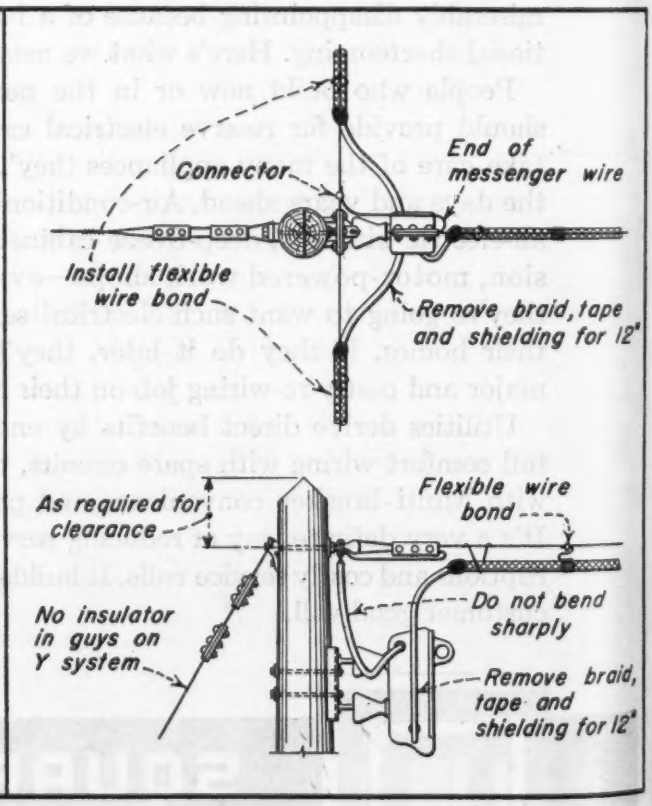
2—Apply insulating rubber tape, half-lapped for approximately 2 in. Build up to ¼-in. thickness in center.

3—Reinstall metallic tape as shown and apply two layers of friction tape half lapped over cone shielding and paint with insulating paint.

2—SECTIONALIZING CUTOUT



3—SINGLE-PHASE TAP


Connector
End of messenger wire
Install flexible wire bond
Remove braid, tape and shielding for 12"
As required for clearance
Flexible wire bond
Do not bend sharply
No insulator in guys on Y system
Remove braid, tape and shielding for 12"

Only with PHILCO Floté Batteries
DO YOU GET ALL
THE ADVANTAGES OF MODERN
FULL FLOAT SERVICE
THE ECONOMY, efficiency and ease of maintenance identified with full float service are measurably increased when Philco Floté Batteries are on the job.
Only Philco Storage Batteries have the famous Floté grid, designed and cast in a special high-efficiency metal expressly for the full float system. The result is—with Philco low cells are eliminated; internal losses are lower; charging and maintenance costs are reduced; batteries last longer.
The many advantages of Philco Floté Batteries have been demonstrated by many progressive utility engineers who use modern Philco Floté Batteries for oil switch control and emergency power requirements.
Write for latest catalogs of Philco Storage Batteries—in modern steel glass, rubber or Vitrabloc jars. PHILCO CORPORATION, Storage Battery Division, Trenton 7, New Jersey.
Makers of the famous Philco "Thirty."
FOR 50 YEARS A LEADER IN INDUSTRIAL
STORAGE BATTERY DEVELOPMENT
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Pole Yard Equipment Eases Pole Handling

Details of and equipment at the Delaware Rural Electric Association (Greenwood, Del.) pole yard provide for orderly storage and for ease of pole handling. Facilities, which were designed and built by Norbert Porter, general line foreman, are provided for storing poles not only according to lengths but also segregated according to class. Ease of handling is provided by two derricks which are so placed that all classes of commonly used lengths can be lifted from the pile and placed on the trailer with a minimum of effort.

Derrick at the right (Fig. 1) can reach all classes in the 25 and 30-ft. lengths and the one at the left, the 35 and 40-ft. lengths. Since few 50-ft. poles are used on the system and since the cost of installation appeared out of line with its infrequent use, no derrick was provided for the 50-ft. pole pile.

Mast of each derrick is made of a 30-ft. Class 4 southern pine pole; the boom, a 25-ft. Class 7 and the pusher, a 25-ft. Class 6. All stubs are made of damaged poles. The mast rests on a footing made of a 2-ft. section of creosoted pole, split and laid flat side down.

When a pole is needed from the pile, the trailer is detached from the truck in front of the proper derrick.

FIG. 2—Placing a 35-ft. southern pine pole on the trailer is a simple task with the crane; the truck does the work

The boom is swung around and the ice-tong-like hook is placed on the desired pole. Lift is provided by the truck through a pulley block and rope arrangement. With one man at each end of the pole, it is swung around and lowered onto the trailer. The complete operation, from time of arrival to time of leaving, takes about five minutes.

•

Drying Transformers*

I—With Coils in Oil

W. C. SEALEY
Engineer in Charge of Design
Transformer Section
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Approved methods of drying transformer core and coils may be broadly divided into two classes:

(1) Drying with the core and coils in the tank with oil.

(2) Drying with oil removed. Core and coils may or may not be removed.

* Part I of a three-part series.

Drying coils with oil in the transformer tank involves heating the windings and oil to a high temperature for a limited time by applying a short circuit to one winding and enough voltage to the other to circulate a partial load current in the windings. Elevated temperature is secured by blanketing the tank or reducing the flow of water in water-cooled transformers. When a transformer is short circuited in this manner only a fraction of normal voltage should be applied to the other winding.

If the load on the transformer does not exceed one-half or three-quarters of the full load rating, winding temperature will not be greatly in excess of the maximum or top oil temperature. Therefore, high oil temperatures can be used safely without danger of causing deterioration of the insulation from local overheating. With good ventilation (top of tank should be open to air) moisture will escape as vapor to the outside and will not condense on the under side of the cover or elsewhere in the tank.

The accompanying table shows the short circuit current in percent of full load current which may be used for this method of drying transformers, with the corresponding maximum allowance of top oil temperature in degrees C. These temperature limits and loads must be strictly adhered to in order to obtain the desired results

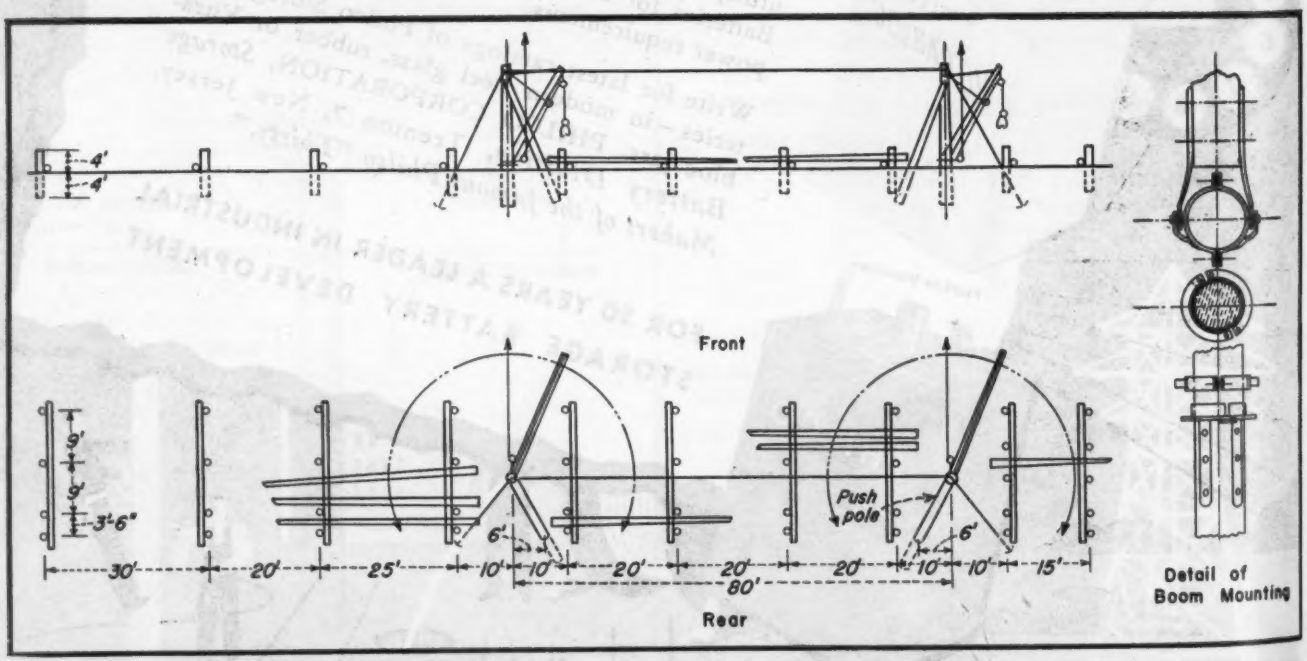
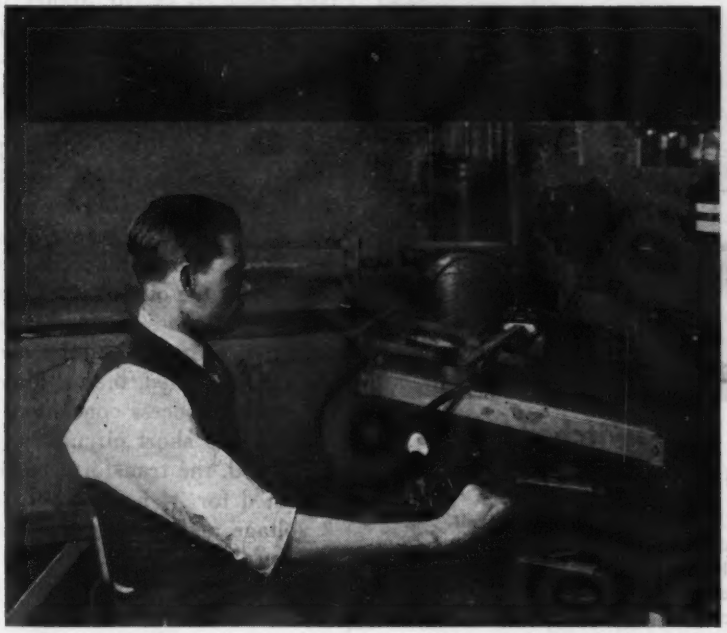


FIG. 1—Pole yard plan which has the facilities for storing 50, 40, 35, 30, and 25-ft. poles with various classes further segregated by 8-ft. stubs planted 4-ft. in the ground. Two pole-cranes serve the four most commonly used lengths. Crane masts are supported by 7/16-in. guy wire to minimize side-sway. Details (at right) are of boom collar

3RD TEST OF A SERIES

Reliable proves that STRAIGHTLINE SPLICES AND DEAD ENDS ARE CORROSION RESISTING

Reliable's policy of systematic testing also includes a relentless battle against the common enemy "corrosion". Specimens of Reliable Connectors, Splices and Deadends are constantly subjected to salt spray and acid vapor tests and checked for conductivity. This conductivity is excellent in tests equalling more than a lifetime of atmospheric corrosion. Note the actual test specimens below.



Above photograph shows actual corrosion test and equipment devised by Reliable engineers to best study this important test requirement

Seeing is believing—watch for other test proof

1. Gripping Test
2. Vibration Test
3. Corrosion Test
4. Conductivity Test

RELIABLE ELECTRIC COMPANY, CHICAGO

OVER 35 YEARS SERVICE TO THE UTILITIES

Full rated conductivity whether the switch remains closed for years or is operated frequently

The contacts of Hi-Voltage Switches are line type, self-aligning and self-cleaning. A ductile powdered metal alloy of silver and nickel is brazed to the copper parts. The silver alloy combines the permanent low resistance contact of fine silver with the non-gauling, long life characteristic of the silver-nickel alloy. The work hardening characteristic of nickel in the alloy produces a hard contact surface. The nickel also imparts to the contact material a lubrication effect.

Positive pressure to develop the maximum conductivity is maintained by stainless steel springs.

The contact cannot be damaged by closing a circuit of thousands of amperes or in opening under heavy load. They are protected by three auxiliary contacts — the horns — the base guide for the blade — and the bronze sleet hood.

In short Hi-Voltage attention to details results in contacts which maintain conductivity—through a life beyond that of the station.

HI-VOLTAGE
EQUIPMENT COMPANY
2891 East 79th Street • Cleveland 4, Ohio

Short Circuit Current for Drying Transformer Coils under Oil

Self-cooled Transformers Short circuit current % F. L.	Water-cooled Transformers Short circuit current % F. L.	Max. Top Oil Temperature
50%	50%	85 deg. C.
75	60	80
85	75	75

without danger to the units. Usually less than 5 percent of normal voltage will give sufficient current circulation in the windings.

It should be noted that the higher the allowable temperatures the smaller the load is. This means that more blanketing of the tank or less water circulation is required for the smaller loads to bring oil temperature to values tabulated.

Drying should be continued until oil from the top and bottom of the tank tests 26 kv. or higher between 10-in. disks spaced 0.1 in. apart for seven consecutive tests 4 hr. apart. Oil should be maintained at the maximum temperature for the load held—without filtering. All ventilating openings should then be closed for another 24 hr. without filtering the oil and oil should be tested as before at 4 hr. intervals. A decrease in the dielectric strength of the oil indicates that moisture is still passing from the transformer into the oil, and the ventilators should be opened, the oil filtered and the drying process continued.

After the short circuit run is discontinued, the transformer should be operated for 24 hr. at approximately $\frac{2}{3}$ voltage and at the same high temperature. If necessary, tests should again be taken on oil samples and the oil filtered if indicated. After a satisfactory $\frac{2}{3}$ voltage test, full voltage should be applied for 24 hr. and the tests repeated. Water cooled transformers may require water circulation to hold top oil temperature to the 85-deg. C. limit during test.

•

Sandblasting Removes Oil Sludge Stain

In a program of cleaning and rehabilitating oil filled porcelain bushings of oil circuit breakers and potential and main transformers at its Newark substation, the Pacific Gas & Electric Co. encountered the problem of removing the heavy oil sludge stain from the inside of the porce-

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More and more, product engineering is taking into consideration the advanced potentials of MOSINEE. Through cooperation with the "paperologists" of The Mills of Mosinee, many manufacturers and converters have improved the quality of their products, broadened utility, lowered cost, expanded present markets and opened new ones.

The Mosinee laboratories, efficient production facilities, and paper engineering leadership are prepared to cooperate in creating specific types of MOSINEE for your products, or in improving your processing.

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PANEL INSTRUMENTS

Guaranteed ACCURACY

Due to design characteristics and close control of manufacturing processes, Burlington instruments embody the following advantages:

PERMANENCE OF CALIBRATION . . . All DC instruments employ Alnico magnets which are known to be more highly resistant to shock, heat, vibration, and stray fields than any other magnetic material.

FREEDOM FROM STICKING . . . Clearances for all moving parts are such that the results of entrance of small particles as encountered in field service are reduced to a minimum.

STABILITY OF OPERATION . . . All instruments are "NORMALIZED" after assembly to eliminate "zero shift" and other calibration errors due to ageing.

Exceptionally high torque to weight ratio of control springs to moving element insures minimum error under conditions of shock, vibration, and other rough usage.

Alignment of jewels and magnet core piece is such that the center lines of these parts coincide within plus or minus .002". The design of the brass movement frame and components is such that mechanical tolerances are reduced to a minimum in assembly. As a result, jewel and pivot wear is uniform which reduces "frictional torque" of the moving coil.

All series resistors and coils are heat treated and impregnated after wrapping to insure stability and long life.

All ranges AC & DC are available in 2½", 3½" and 4½" sizes, both square and round, flush mounting.

Engineering service furnished for specialized applications. No obligation. Write today for further information.

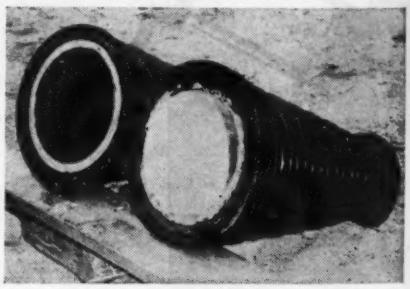
BURLINGTON INSTRUMENT CO.
301 FOURTH STREET
BURLINGTON, IOWA

PANEL INSTRUMENTS • VOLTAGE REGULATORS • AUTOMATIC SYNCHRONIZERS • FREQUENCY REGULATORS

lain. Sandblasting, shown, was found to be the only effective means of doing a quick and thorough job. A matter of three or four minutes is all that is required for a 110-kv. bushing.

SANDBLASTING with river grade sand quickly removes oil sludge stain from inside of porcelain bushings

The smooth white inside of the unglazed porcelain is then given two coats of No. 1,201 red Glyptal lacquer. Purpose of the cleaning is to provide a smooth clean surface for the Glyptal to prevent sludge from again adhering to the porcelain. A reasonably fine sand of about river grade with 50-lb. air pressure was found to be the best combination. Higher pressure



OIL CIRCUIT BREAKER bushing before (left) and after (right) sandblasting

and coarser sand produced too severe an abrasive action. After the bushings are disassembled, the bakelite or Herkolite tubes as the case may be are cleaned with solvent such as Union No. 9 or Stoddard, and then baked in a job-erected electrically heated oven.

An interesting fact came to light in connection with this bushing maintenance program. The condition was found on several current transformer bushings that although the gage glass showed oil, that the oil in the bushing was nevertheless low. What had happened was that the oil passage between gage glass and the bushing interior had become clogged with sludge. Answer to this problem is

PREVENT RUST and SLUDGE

in your turbines

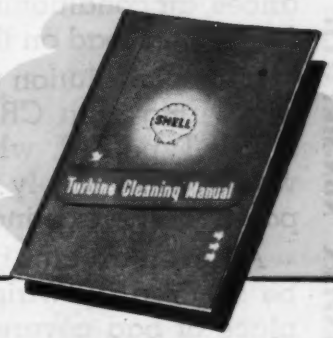
SHELL TURBO OIL IS FORTIFIED to prevent turbine rust and sludge.

Here's the first turbine lubricating oil to actually prevent sludging and rust.

Especially fortified, this oil provides unusual oxidation stability, which prevents the formation of sludge, prevents emulsion-forming products—makes the oil last longer.

Moreover, Shell Turbo Oil stops rust by adhering closely to the metal surfaces, keeping air and water away. And it does not foam.

You'll be surprised at the economy of Shell Turbo Oil . . . To get the facts, contact Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York; or 100 Bush Street, San Francisco 6, California.



A TIP...

Before changing over to Shell Turbo Oil, give your system a thorough cleaning. You'll get even finer results and save money in the long run. The booklet above describes this quick, easy operation. Send for your complimentary copy.

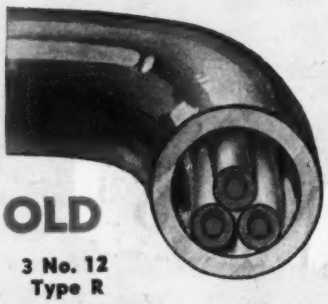
SHELL

SHELL TURBO OIL

RUBBER POWER CABLES • VARNISHED CAMBRIC CABLES • PERMACORD • LEAD-ENCASED AND PARKWAY CABLES • SYNTHOL WIRES • WELDING CABLES • SHIPBOARD CABLES • IMPERIAL NEOPRENE JACKETED PORTABLE CABLES • ARMORED CABLE • CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE CABLE • BUILDING WIRE

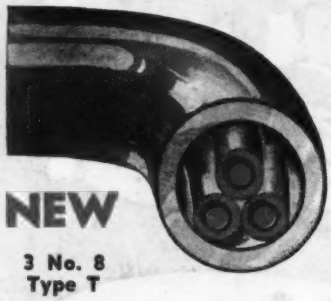
See how

CRESCENT SYNTHOL TYPE T



OLD

3 No. 12
Type R
Carry 20 amps.



NEW

3 No. 8
Type T
Carry 41 amps.

Permits DOUBLE THE AMOUNT OF COPPER *in Existing Raceways*

Illustration shows ½" conduit

Under present conditions there is urgent need for an economical and quick way of adding to the current carrying capacity of branch circuit conduits already installed. Increasing numbers of electrical appliances, air conditioning units and other equipment call for greater load on these branch circuits.

A simple solution to this problem is to replace present wiring with CRESCENT SYNTHOL Type T (formerly Type SN), which offers an easy and low-cost way approximately to double the current carrying capacity of the existing raceway.

An even greater increase in carrying capacity can be secured by wiring with CRESCENT Type TW in place of bad covered cable in wet locations.

Write for Descriptive Folder on SYNTHOL Type T and Type TW

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

CRESCENT WIRE & CABLE

NEMA

regular maintenance at several year intervals. It was also noted that in many cases "fish bowl" type reservoirs had sludge stains that gave a false indication of oil level, further emphasizing the necessity of periodic maintenance.

•

Pulverized Silver Alloy Brazes Small Wires

A method of brazing small round wires with diameters of 0.0226 to 0.049 in. makes use of a mixture consisting of equal amounts of filed silver solder and borax flux. This method has been adopted in the Distribution Transformer Division at General Electric's Pittsfield Works.

SMALL ROUND WIRES with pulverized silver alloy on one end ready for brazing over an open gas flame

The end of one of the two wires to be brazed is either moistened or heated and then inserted in the container holding the mixture. When a sufficient amount adheres to the wire, the two ends are placed together and heated over a gas flame until the alloy fuses them. If normal heating is applied, the joint will be free of lumps and points, eliminating a finishing operation before the braze can be insulated.

In the conventional method of brazing the small wires, a strip silver alloy and flux was used. This resulted in a loss of the silver both from drip at the braze and from an excess of brazing material at the point of contact. The new method has resulted in a saving of approximately 80 percent of the strip silver alloy.

Specifying CHANCE ANCHORS gives us a complete line to choose from . . .

System expansion plans should include anchors to fit the conditions

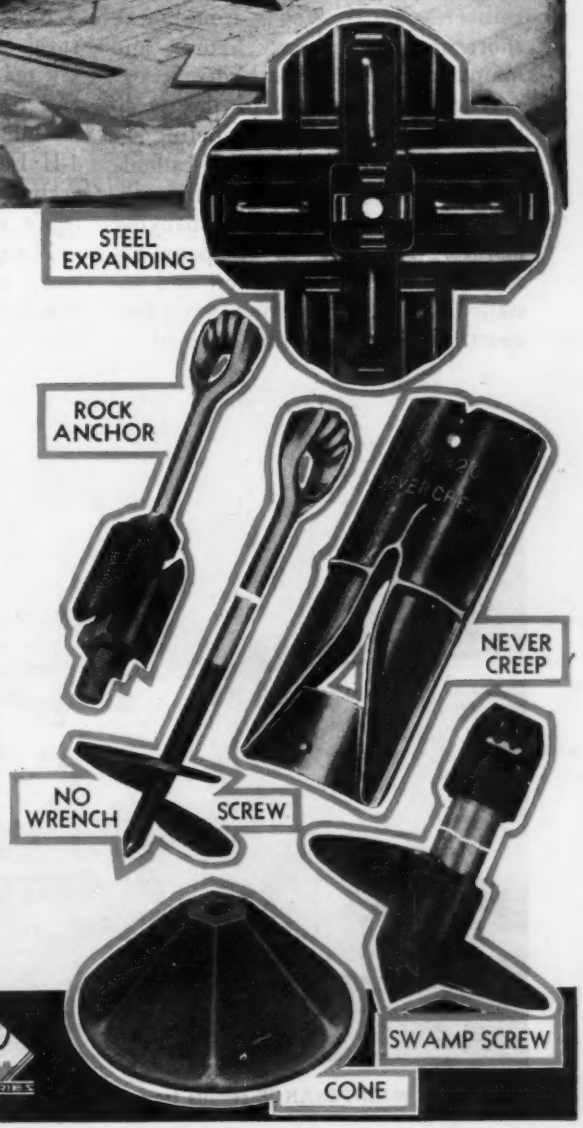
When postwar plans for line extension finally begin to materialize, there will be Chance Anchors available to meet the most exacting specifications.

To insure the greatest protection for investments in new construction, to get the most efficient anchoring under all soil and guying conditions, plan to make anchor selections from this—the most complete line. Standardize wherever possible, of course, but bear in mind that one anchor just won't do the job as it should be done under all conditions. That's why Chance Anchors are made in so many types and sizes. That's why it pays to specify Chance Anchors in order to meet any and all requirements.

Here are a few of the most prominent types. There are several others and many sizes. Where soil and guying conditions are known factors, definite anchor selections can be written into your specifications now. Your Chance catalog of Pole Line Equipment, the Chance Guy Calculators (available on request) will help you in making these selections. If possible, plan ahead and place your order for future delivery. If your need is immediate, perhaps the anchors can be supplied by your Electrical Jobber now.

Thousands of these anchors are delivered daily to the Signal Corps and other branches of the armed forces, throughout the world. Most of our production is booked months ahead, but come the postwar period, we'll be all geared up to help you carry out your postwar construction plans.

BUILD SECURITY INTO YOUR LINES



A·B·CHANCE CO·
CENTRALIA, MISSOURI.

LOAD SERVICING

Commercial
Industrial

Residential
Rural

Cold Cathode Solves Maintenance Problem

J. R. TAYLOR
Industrial Sales Department
Duquesne Light Co., Pittsburgh, Pa.

Rusting and corrosion of metal parts of fixtures were easily foreseen if conventional lighting were installed over the hot baths of a "Parkerizing" department newly added in the plant of the McLean Manufacturing Co., Pittsburgh. Steam from the various vats—degreasing, pickling, neutralizer, water rinse etc.—would make short work of ordinary fixtures and maintenance would be high.

After consideration of the problem, Duquesne Light illuminating engineers recommended cold-cathode tubing mounted directly on the ceiling as appears in the accompanying picture. The McLean company accepted this recommendation and installed the tubing in rows seven feet apart. Since the tubing is held in position by simple strip hangers, a minimum amount of metal, easily replaceable, is exposed to the moist air. The installation has proved to be highly satisfactory. For the work of loading and unloading tanks, the ten foot-candles of the installation are entirely adequate.

•

Utility Sponsors 4-H Electric Clubs

Keenly aware of the importance of rural electrical education in promoting maximum agricultural prosperity and development, Mississippi Power & Light Co. is sponsoring a statewide 4-H Electric Club program in cooperation with Mississippi State College's extension service.

Promotion of better knowledge and more efficient use of electricity on Mississippi farms is the objective of this broad program, which was launched in April, 1945, and which to date has enrolled a total of 914 members in 65 boys and girls clubs. As of July 1, there have been organized 32 boys clubs with a total of 403 members, and 33 girls clubs with 511 members.

The 4-H Electric Clubs will help Mississippi farm boys and girls to:

1. Use electrical equipment to increase food, livestock and poultry production and to relieve the farm labor shortage.

2. Conserve electrical equipment and electric power by keeping all equipment in good working order, and by using electricity and equipment only for essential purposes.

3. Acquire a working knowledge and skill in the most effective use of electricity on the farm.

4. Develop plans now for using electricity and electrical equipment most effectively and efficiently in the improvement of the farm, the home, and the community during the years ahead.

Technical Assistance Given

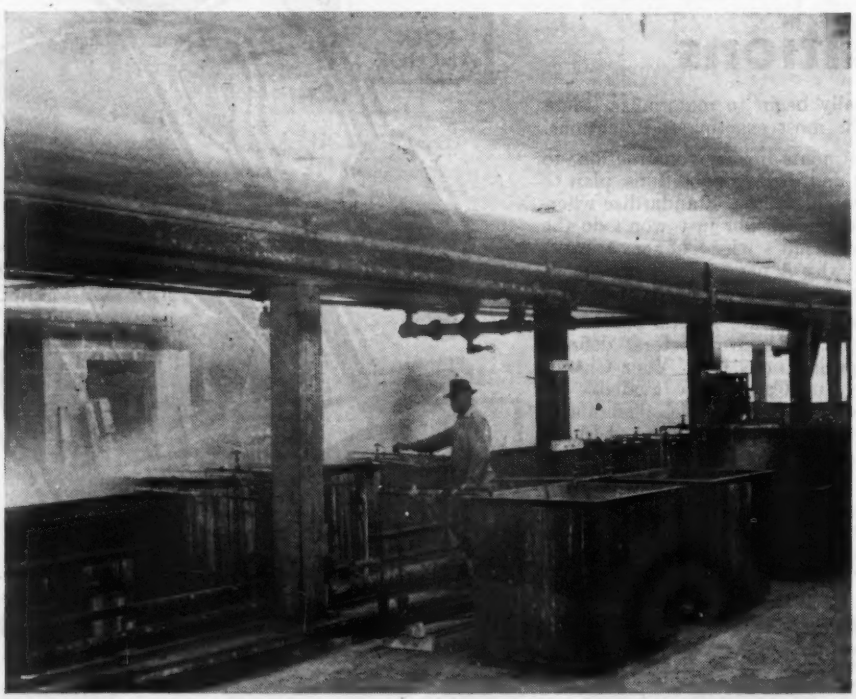
The company furnishes technical assistance in the teaching of all clubs and offers incentive awards for participation in the Electric Club work. Those earning awards are selected by Extension personnel.

To stimulate interest in this program Mississippi Power & Light Co. is offering 4-H Electric Club boys and girls 90 free trips to the Mississippi State "4-H Round-Up" to be held in Jackson in October of this year. This Round-Up will bring 4-H winners of all club sponsored projects to Jackson for two or three days.

The prizes include four statewide merit awards to boys and four to girls. In addition to the statewide prizes, the company is offering a free trip to the outstanding Electric Club boy and girl in each of the 41 counties in which the company operates.

The expansion of electric service to Mississippi farms will open new opportunities to farm youth and a program, jointly sponsored by the State extension service and the state's largest electric utility company, will give Mississippi farm boys and girls the "know how" to put electricity to the most profitable use on their farms and in their farm homes.

Complete plans for the 4-H Electric Club program and for company par-



MINIMUM MAINTENANCE results from cold cathode lighting over "Parkerizing" vats

New RCA 26-42 MC (Mobile or Station) FM Transmitter Features

1. Superior audio quality sets new standard. Sounds better. Easier on the ear. Easier to get message.
2. Positive modulation threshold limiter. Adjusts automatically to input of low or loud voices. No "blasting."
3. Low spurious emission. Less extraneous noise interfering with other services. Fewer energy leaks to make trouble.
4. Improved phase modulator requires no tuning. No more bother with modulator.
5. Excellent stability over wide temperature range. Temperature change has minimum effect on operation of equipment.
6. Adjustable to exact, specified frequency. Easy, precise tuning in a hurry.
7. All tuning adjustments are from top of transmitter. Easily accessible. (Remember those times you have had to turn the chassis over?)
8. No high voltage exposed above chassis. All dangerous voltage out of reach. (Many times a slip of the hand might have given you a shock.)
9. Provision for two-frequency operation. Useful when you want to switch over from talking between car and station to talking between car and car (and in lots of other ways).
10. Single control cable—also accommodates receiver. One cable, instead of three or four, running from front of car to rear. Simplifies installation and maintenance.
11. Mobile cables equipped with separable connectors. Add flexibility in operating equipment. Equipment removable without using special tools. All cables plug in and lock.
12. Chassis readily detached from base. Easier to inspect and service.
13. Single-unit construction saves space.
14. Easy to install. Mounting hardware supplied. Comes complete, down to bolts and nuts.
15. Start-stop switch on chassis to facilitate adjustment. (Think how much better this is than having to go up front and press a button to turn on the transmitter.)

New FM 26-42 MC (Mobile or Station) FM Receiver Features

1. Superior adjacent-channel selectivity. You hear the station you want to hear.
2. Low spurious response. Won't pick up unwanted signals.
3. Excellent stability over wide temperature range. Variations in temperature have minimum effect on operation.
4. Single-unit construction. Fewer interconnecting cables. Easier to service.
5. Easy to install. Mounting hardware supplied. Comes complete, down to last nut and bolt.
6. Chassis readily detachable from base. Easy to remove for inspection and servicing.
7. Mobile cables fitted with separable connectors. Cables plug in and lock. Require no special tools. (Another important point—you can't plug in the wrong cable!)
8. Low battery drain. Less battery servicing.
9. Class B output tube saves power on standby. Output stage takes very little power except when signal is being received.
10. Provision for carrier-operated relay. Can be used to operate other circuits for auxiliary signalling—turn on light, ring bell, etc.—or operate retransmitting equipment.
11. Single crystal. Eliminates potential trouble with matching crystals.
12. Attractively styled. And we mean darned good-looking.

Yes you can get early delivery

OF *RCA's* NEW RADIO EQUIPMENT FOR POWER COMPANIES AND OTHER UTILITIES

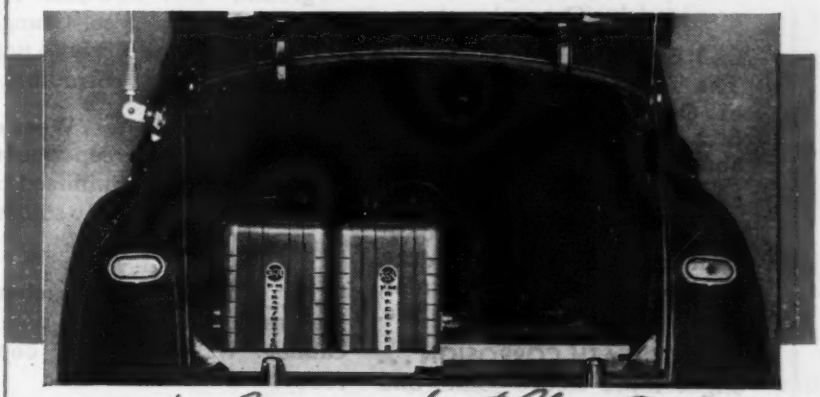
—but orders are pouring in!

● Never before have power-company and other utilities officials been offered radio so efficient, so usable, so convenient, from every angle.

Think of it—utilities service radio that tunes easier, sounds better, clearer—radio that is more selective, more stable—requires less adjustment, less maintenance—and can be serviced more easily, more quickly, more safely.

In the narrow limits of this space, we can't possibly give you the story—tell you all you'll want to know about this new equipment.

All we can do here is to give you the outstanding features listed in the column at the left. But all the facts—description, specifications, complete data—are in a new RCA bulletin now ready. Let us send you a copy—fill in and mail the coupon below—and you'll get it by return mail.



Mail this Coupon and get New Bulletin!

For Complete Information, Specifications, Pictures, Diagrams—Use This Coupon

EMERGENCY COMMUNICATIONS EQUIPMENT SECTION
Radio Corporation of America, Camden, N. J.
Please send me complete data about your new FM Radio Equipment for Electric Light and Power Companies and other Utilities.

Name.....

Title.....

Employed by.....

Street Address.....

City and State.....

1440

RCA

Buy War Bonds

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

In Canada, RCA VICTOR COMPANY LIMITED, Montreal

"Maintenance—that's somethin' you don't hear much about with ORANGEBURG!"

Consider these common causes of cable failure and the dependable protection against each provided by Orangeburg:

CABLE SHEATH ABRASION . . . The remarkably smooth bore of Orangeburg ducts assures protection against scoring or abrasion.

PULLING TENSION . . . The coefficient of friction is lower than in other types of duct. Result—less chance of strains, longer pulls, greater cable life.

CABLE SHEATH CORROSION . . . Tight taper sleeve joints and the impermeable wall of Orangeburg prevent infiltration of ground waters and other corrosive elements. Also, Orangeburg material itself is both non-corrosive and non-corrodible.

CABLE MOVEMENT . . . Wear or abrasion, during creep due to changing load, is minimized by Orangeburg's unusually smooth surface.

Other important Orangeburg features are described in a new catalog. Write for your copy *today!*

THE FIBRE CONDUIT COMPANY • ORANGEBURG, N. Y.
Graybar Electric Co. Inc. • *Distributors* • General Electric Supply Corp.

ORANGEBURG FIBRE CONDUIT

THE FIBRE CONDUIT CO. ORANGEBURG N.Y.

ORANGEBURG

WITH 50 YEARS EXPERIENCE IN THE MANUFACTURE OF NON-METALLIC CONDUIT AND PIPE, SERVES THE POWER AND LIGHT, TELEPHONE, GENERAL CONSTRUCTION, CHEMICAL, PETROLEUM, PLUMBING AND BUILDING SUPPLY FIELDS WITH ELECTRICAL FIBRE CONDUIT . . . ELECTRICAL UNDERFLOOR DUCT SYSTEMS . . . AND FIBRE PIPE FOR NON-PRESSURE USES.

ticipation therein have been presented in key localities in the state by J. J. Powell, residential and sales promotion Manager, Les M. Taylor, general sales manager, and H. S. Johnson, State 4-H Club Director, State extension service.

These meetings were attended by all division managers, district managers, local and combination managers, division power consultants, power consultants, and home service advisors. Local state extension service representatives also attended these meetings. Keen enthusiasm marked the meetings, and the 4-H Electric Club program has every promise of success.

•

Electric Applications in Greenhouses

Four electrical devices, that is, soil sterilizing units and three types of ray lamps, are helpful in greenhouses, to stamp out disease and to step up production, according to electrical manufacturers.

The sterilizing units are used to heat soil to a temperature of 160 to 180 deg. F. for 30 min., killing plant disease organisms, fungi, insects and weeds.

Ultra violet lamps supplement the sun by providing an extra supply of vitamin D.

Infra red lamps are used to provide localized applications of heat.

Fluorescent lighting, duplicating daylight, is used to exhibit flowers and plants in their natural colors.

•

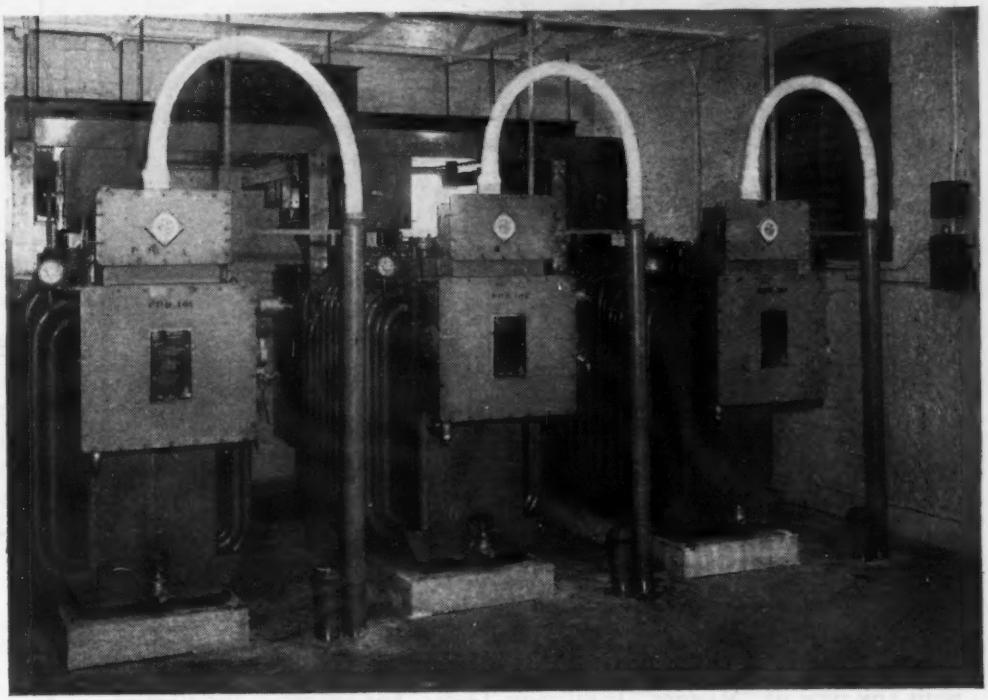
Poultry Water Warmers for Home Construction

Shown are two types of poultry water warmers that are being recommended to farm customers by the Cincinnati Gas & Electric Co. Both designs can be built in the farm work shop.

An old piece of galvanized downspouting, a No. 2 tin can, a piece of galvanized sheet steel, some solder, a length of rubber-covered two-wire extension cord, a bushing, a socket, light bulb and sand are all that's needed for the "immersion" heater shown. It can be used in an ordinary 10 or 12-quart galvanized bucket. Since it is not thermostatically controlled, however, wattage of the lamp used must be selected to suit the

Why Wall'Em Up...

WHEN YOU CAN USE AMERTRAN ABESTOL IMMERSED TRANSFORMERS



Installation of Abestol immersed net work Transformers installed in State Department Building, Washington, D. C. 500 KVA, 3-phase; primary 13,800 volts; 60 cycles; secondary 208/120 volts.

"Out of sight, out of mind", applies to transformers as readily as to anything else. True, modern transformers require very little maintenance—but that little is important and must not be neglected. When you have to put a transformer in a vault, it becomes less accessible. Out in the open installations save valuable floor space and the cost of special vault construction.

On the other hand, Abestol, being an incombustible dielectric, eliminates an important fire hazard, and makes vaults unnecessary. It provides excellent insulating properties and similar heat transmission characteristics, without the sludging of transformer oil.

Specify AmerTran Abestol Immersed Transformers and gain the conveniences, accessibility and flexibility of vaultless indoor installation.

AMERICAN TRANSFORMER COMPANY, 178 Emmet St., Newark 5, N. J.

AMERTRAN

REG. U. S. PAT. OFF.

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

Now in production in our Philadelphia factory.

with a

Midget "Megger"* INSULATION TESTER

Making important check tests of insulation resistance is a one-man job with any type of "Megger" Insulation Tester. For example, the illustration shows our Midget type being used for a periodic test on one of a group of fire-pump motors. After making connections, the operator merely turns the crank of the hand generator—and reads resistance directly on the scale. It is done as simply and quickly as the telling.

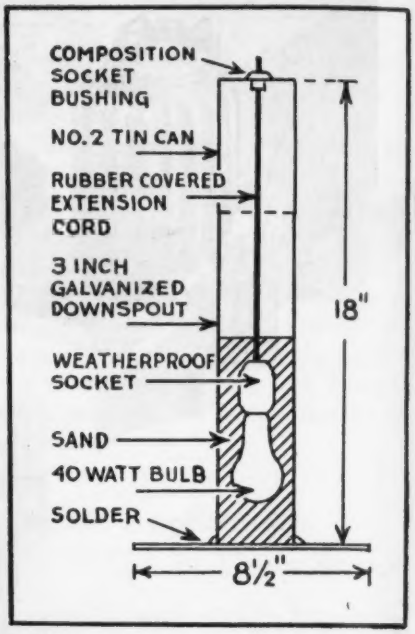
The Midget "Megger" Tester is ideal for maintenance and trouble-shooting because of its light weight, small size and ready portability. The hand-cranked generator makes it independent of batteries or external power supply—it is instantly ready for testing insulation resistance of almost any type of electrical equipment. Reads up to 50 megohms and delivers 500 volts d-c. Supplied also in ratings of 10 megohms, 100 volts and 20 megohms, 250 volts.

For periodic maintenance tests or where trouble has occurred the Midget "Megger" Tester has won wide favor with the men who use it. Its low cost has been attractive. For complete description write for Bulletin 1785-W.

** By special arrangement with the British makers of "Megger" instruments our American-made models carry the U. S. Registered Trade-mark "MEGGER".*

JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

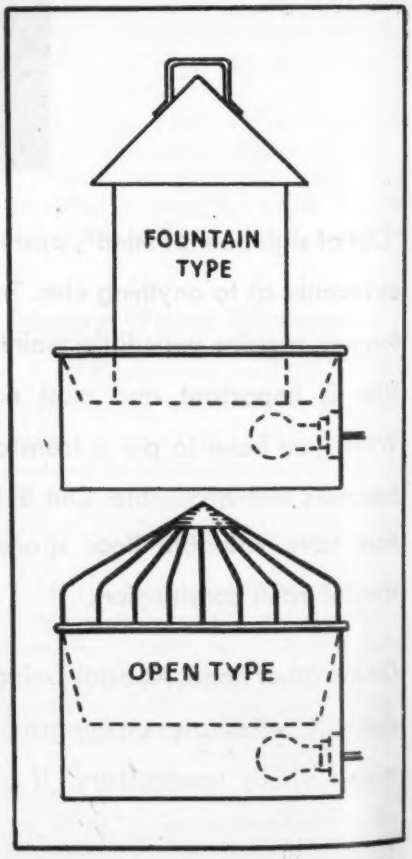
poultry house temperature and the amount of water to be warmed. If a bucket is used it should be set into a



IMMERSION-TYPE water warmer easily made in farm shop

platform so the chickens can reach the water without difficulty and without upsetting it.

Fountain or open-type water containers can be warmed with a second-type heater, even more simple to



RING-TYPE poultry water warmer proposed for farm shop construction

OUT OF THIS WAR
—the Red Diamond Engine

International Red Diamond Engine. Heavy-duty power for heavy-duty work. Ample power and capacity—surprising economy. Proved in actual combat warfare, now available for civilian service.

THE rugged requirements of warfare on every battlefront have inspired the engineering genius of American industry.

Out of this war has come, for example, the *new International Red Diamond Engine.*

Tens of thousands of International Military Trucks and Half-Tracks—powered by this new International Red Diamond Engine—have set new transportation and combat records in wartime service.

Many of these mighty Red Diamond Engines have already gone into International Heavy-Duty Trucks for essential civilian use. The men who operate them will vouch for the stamina and economy of adequate power for any job.

When new trucks roll out in volume on America's highways, look to International for even greater economy, even greater dependability. And remember—for ten years before the war *more heavy-duty Internationals were sold than any other make.* Backed then, as now, by the *world's largest company-owned truck service organization.*

INTERNATIONAL HARVESTER COMPANY
180 N. Michigan Ave. Chicago 1, Illinois

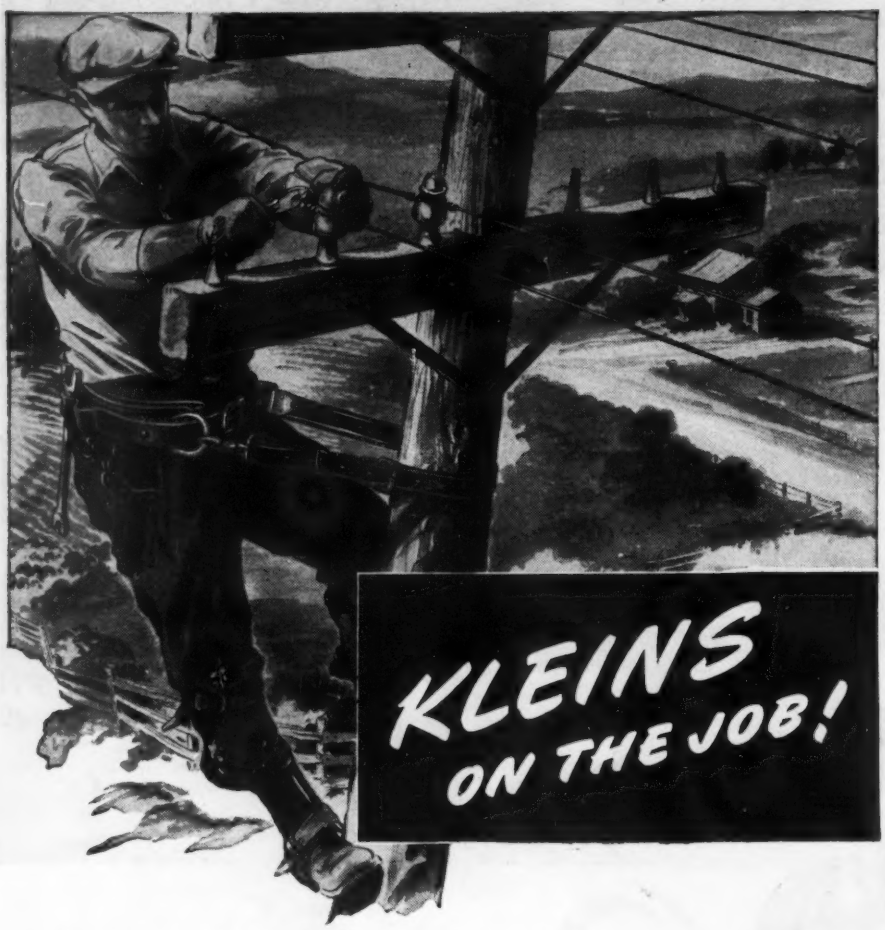
NEW TRUCKS: The government has authorized the manufacture of a limited quantity of light, medium and heavy-duty International Trucks for essential civilian hauling.

SERVICE: Many operators will have to wait for trucks. Maintenance of existing vehicles is just as important today as before V-J Day. Therefore—be sure your trucks get top care and service at International Truck Dealers and Branches.

INTERNATIONAL HARVESTER

INTERNATIONAL

INTERNATIONAL Trucks



● There's a mighty job to be done on the power and communication lines in America—improving present facilities—extending new lines to bring service to new users—both domestic and industrial.

Utility companies are laying plans now to start this program as soon as conditions permit. And included in their plans are new tools and equipment for the thousands of linemen and electricians required by this development. Klein pliers and Klein equipment will be on the job serving these men in the electrical industry as they have "Since 1857."

ASK YOUR SUPPLIER
***Foreign Distributor:* International Standard Electric Corp., New York**

This book on the care and safe use of tools will be sent on request.

Since 1857

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

build. It is made from a strip of galvanized sheet steel bent into an open-ended cylinder and riveted. Height and diameter of the cylinder depend on dimensions of the fountain. The lamp heat source should be bolted inside the ring and almost touching the bottom of the fountain. Rubber-covered extension cord should be brought inside the cylinder through a porcelain bushing. Since thermostatic control is lacking, selection of the lamp should again fit temperature conditions. A 40-watt size lamp will usually serve for average conditions.

It is well to place this type of fountain on a wood-frame platform covered with 1-in. mesh hardware cloth to prevent litter from being scratched into the water. Spilled water will fall through the mesh to the litter below.

•

Television for Merchandising

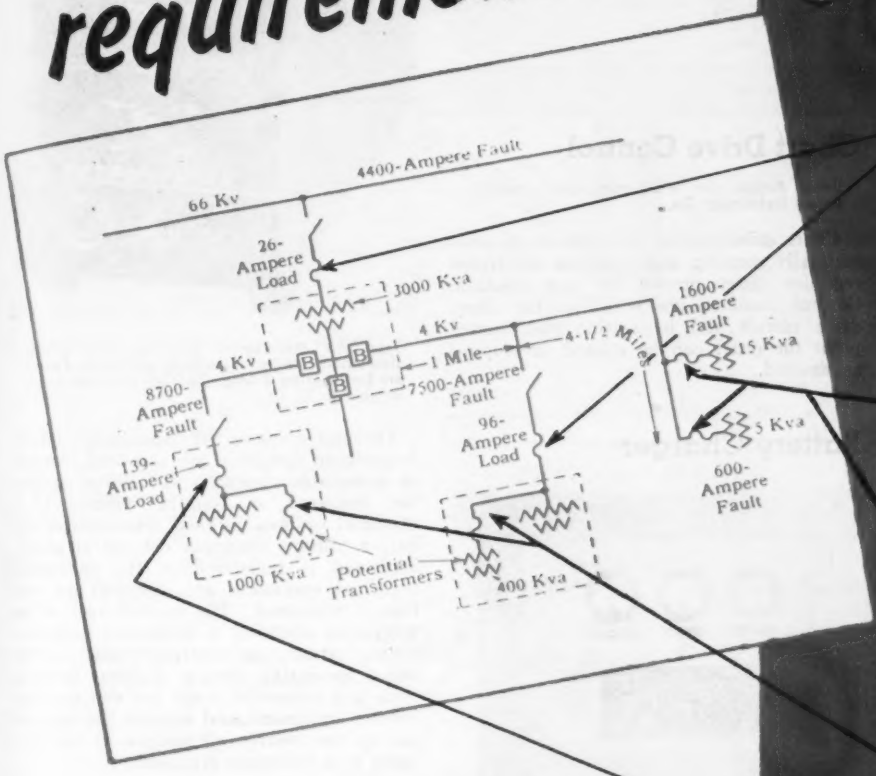
At a cost of $1.19 per hour each, a department store can show new styles and demonstrate merchandise, can carry many kinds of sales messages, on 20 television screens located in show windows and throughout the sales areas. So says the General Electric announcement of a wired television system, "Itra-Tel", basing the statement of cost on prewar prices and on operation 40 hours per week.

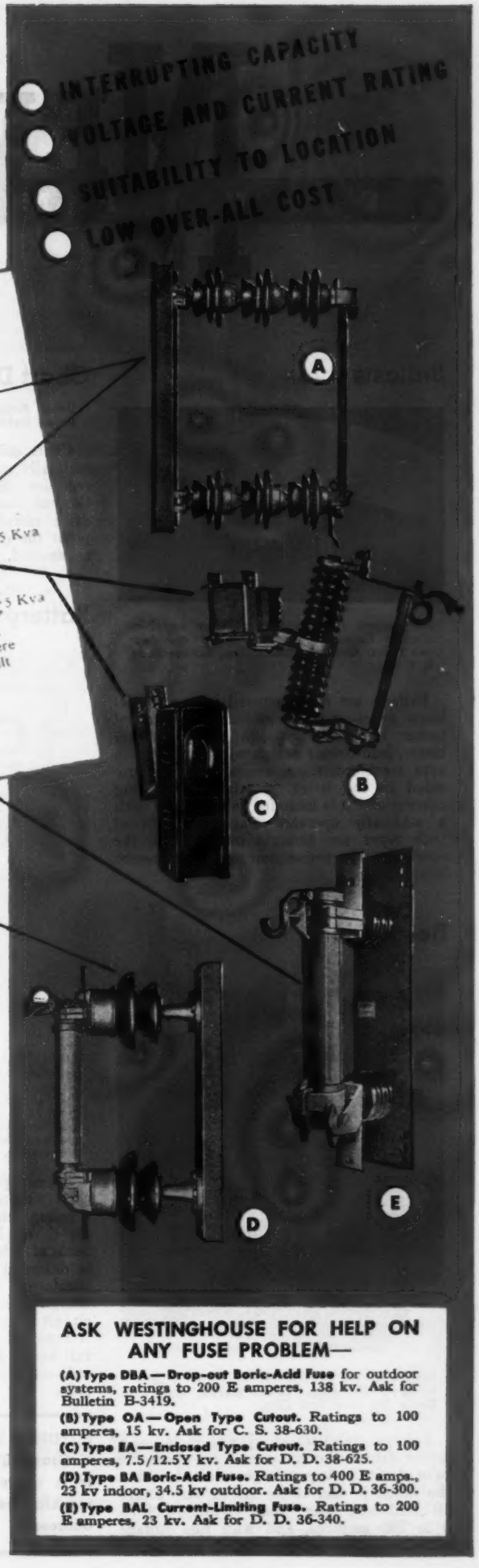
The cost of the system, including all equipment and installation for ten camera stations and the 20 display points, is estimated at $65,000. This investment, depreciated over ten years, results in an annual charge of $6,500. To this is added $40,000 per year for salaries of technical and other operating personnel. Replacement of tubes and parts is set at $2,000 annually. The final item of cost is electricity, 30 kw., 40 hours per week at 1½ cents per kw.-hr., which comes to $1,000 per year. The total of these costs is $49,500 or $23.84 per hour for the 20 receiver points.

In addition to showing and demonstrating merchandise throughout the store the system can be used for broadcasting over a television station. Also for training sales personnel and for personalized announcements of all kinds.

all 4 basic requirements of

- INTERRUPTING CAPACITY
- VOLTAGE AND CURRENT RATING
- SUITABILITY TO LOCATION
- LOW OVER-ALL COST





...are met by a type of fuse from the *complete line of Westinghouse fuses—for ANY service*

The Westinghouse fuse service—the most complete line of fuses available anywhere *plus* decades of fuse application experience—is yours for the asking.

If you are in doubt about the rating, or suitability of any type of fuse for service in your system, why not consult a Westinghouse engineer? When full consideration is given to the four basic requirements listed above, selection of the proper fuse is simplified. It becomes clear why one fuse should be used in preference to another—especially when over-all cost is considered. So call your Westinghouse office and save time.

The fuses shown at right typify the completeness of the Westinghouse line of fuses . . . for all power distribution and industrial services . . . in all kinds of operating conditions. For more information ask for bulletins indicated. Write to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-60579

ASK WESTINGHOUSE FOR HELP ON ANY FUSE PROBLEM—

(A) Type DBA—Drop-out Boric-Acid Fuse for outdoor systems, ratings to 200 E amperes, 138 kv. Ask for Bulletin B-3419.

(B) Type OA—Open Type Cutout. Ratings to 100 amperes, 15 kv. Ask for C. S. 38-630.

(C) Type EA—Enclosed Type Cutout. Ratings to 100 amperes, 7.5/12.5Y kv. Ask for D. D. 38-625.

(D) Type BA Boric-Acid Fuse. Ratings to 400 E amps., 23 kv indoor, 34.5 kv outdoor. Ask for D. D. 36-300.

(E) Type BAL Current-Limiting Fuse. Ratings to 200 E amperes, 23 kv. Ask for D. D. 36-340.

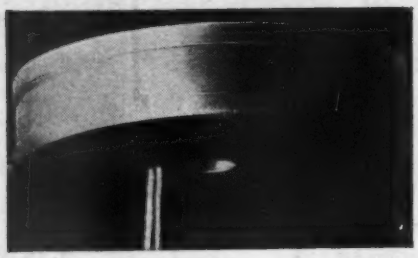
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

COMPLETE FUSE SERVICE

NEW EQUIPMENT

Ballasts

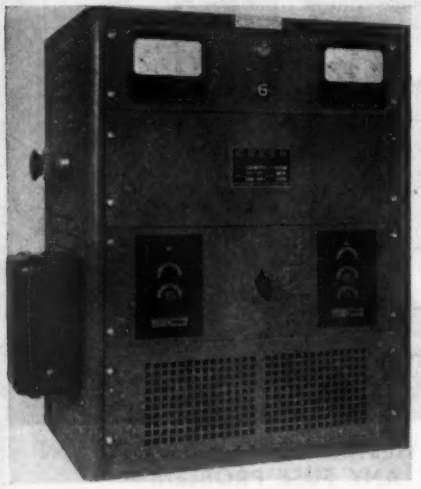


Disc-shaped ballasts for operation of 12-in. circline fluorescent lamps: center mounted; two types. **General Electric Co.**, Schenectady, 5, N. Y.

Ballasts are manufactured in two single-lamp types—a conventional, uncorrected power factor design and a high power factor, lead-circuit design without a step-up auto transformer. A compensator is provided in the latter to raise the starting current and it is intended for use only with a manually operated starter. Leads of both types are brought out through the cover plate for connection to the fluorescent lamps.

•

Rectifier



Stabilized low voltage rectifier: 0 to 3 volts; rated at 200 amp. **Green Electric Co.**, 130 Cedar St., New York City.

Voltage stabilization system includes a motor driven Powerstat and an electronic pilot device. Any voltage selected within the range is said to be maintained within 50 millivolts over load variations from 0 to 200 amperes, and with line voltage variations of plus or minus 10 percent.

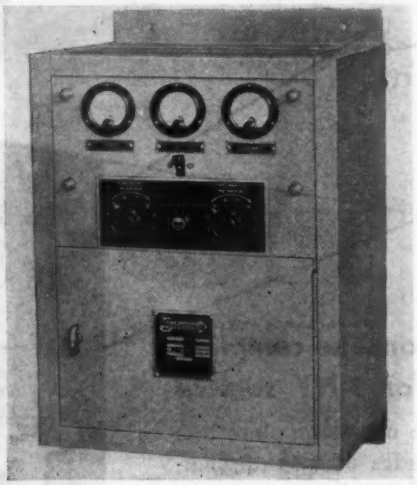
Chart Drive Control

Drive control for electronic chart motion. **Brown Instrument Co.**

Chart drive control is a means of automatically starting and stopping electronic recorder chart motion by pen position. Control contacts are wired in the chart drive circuit and by setting the control point the chart can be started or stopped as desired.

•

Battery Charger



Model "FtR-800-5" telephone battery charger: selenium rectifier type; operates on single phase, 60 cycle, 110, 130, 200, 220 and 250-volt circuit; d.c. output, 2.4 to 16 amp for from 12 to 60 cells; output voltage, 2.1 volts per cell at high charge to 2.25 at trickle charge. **Federal Telephone & Radio Corp.**, Newark, N. J.

Battery potentials are reported automatically maintained within selected limits by a voltage control relay circuit which varies the charge between high and trickle rates, both of which are adjustable. The unit is designed to operate without automatic regulation, if desired, permitting rate of charge to be adjusted manually. The d.c. circuit is filtered; the a.c. ripple component is reported not to exceed 40 millivolts at full load. An alarm circuit is provided to indicate failure of charger or battery circuits.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

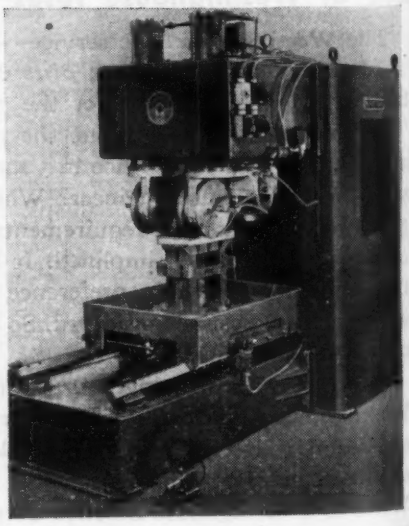
Metalsorter

Type "AX" metalsorter: identifies pure metals, steels and non-ferrous alloys; portable. **Farmers Engineering & Mfg. Co.**, 549 Brushton Ave., Pittsburgh 21, Pa.

The unit employs the triboelectric effect. A metallic specimen of standard, known or acceptable character is rubbed against the unknown or doubtful piece. If a chemical or metallurgical dissimilarity exists, a minute electrical current is generated and is registered on the calibrated scale; if specimens are identical no current is generated. The control unit of the apparatus contains a thyratron, operated timing circuit, an electronic bias supply and a measuring circuit. Various fixtures, tools and connector leads are standard accessory equipment and enables the apparatus to use nearly all shapes of metallic parts as a reference standard.

•

Seam Welders



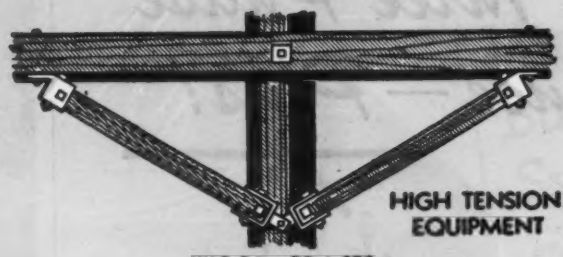
Duplex seam welders: capacities up to 500 kva.; automatic; maximum head of stroke, 7 in.; maximum clearance from work table to welding wheels, 16 in.; maximum table travel, 25 in.; height 87 in.; requires 90 in. by 51 in. floor space. **Progressive Welder Co.**, 3050 E. Outer Drive, Detroit 12, Mich.

Welders are designed for automatic production welding of parts requiring two or

1945 CONSTRUCTION

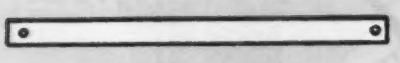
"Hang the Load on Hubbard Hardware!"

STEELWING ANCHORS
2-3/4" to 10" Diam.
1-1/2 Ft. to 8 Ft. Lengths



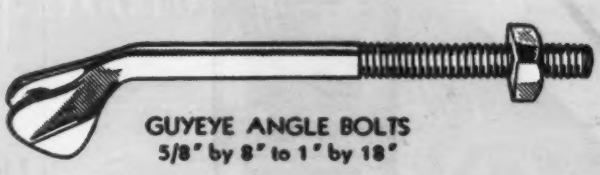
HIGH TENSION EQUIPMENT

WOOD BRACES
All Sizes—Many Types



CROSSARM BRACES
Flat, Ribbed, One Piece, Wood and Steel

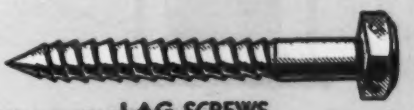
PINS
All Sizes
and Styles



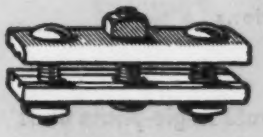
GUYEYE ANGLE BOLTS
5/8" by 8" to 1" by 18"

CARRIAGE BOLTS
All Standard Sizes

CROSSARM & MACHINE BOLTS
3/8" by 1" to 3/4" by 28" Sizes

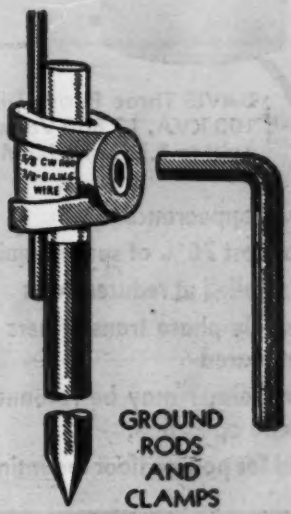


LAG SCREWS
All Standard Sizes



GUY CLAMPS
1-2-3-4 Bolt Sizes

EYE NUTS
All Sizes
and Styles



GROUND RODS AND CLAMPS
Hubbard-Copperweld

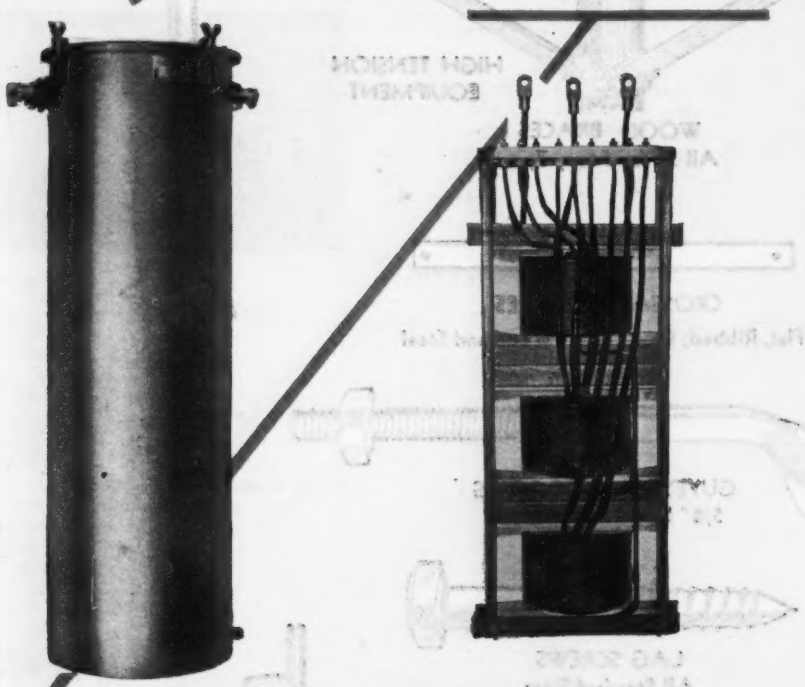
HUBBARD

HUBBARD AND COMPANY

Pittsburgh • Chicago • Oakland, California

DAVIS TRANSFORMERS

Packaged Three Phase Performance—Plus!



DAVIS Three Phase Distribution Transformers Rated 100 KVA, 13,800 Volts and Below. Built to E.E.I. and NEMA Specifications.

- **Improved appearance**
- **Saves almost 70% of space required by separate single-phase units**
- **Easily installed at reduced costs**
- **Three single phase transformers in one tank so that any one section can be easily replaced**
- **The transformer may be reconnected in the field when emergency calls for open delta operation.**
- **Adapted for pole or floor mounting**

DAVIS TRANSFORMER COMPANY

DAVIS TRANSFORMER CO.
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and

STOCKWELL TRANSFORMER CORP.
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Manufacturers of Oil Cooled, Dry Type, Power and Distribution Transformers
Also All Types of Specialty Transformers Regardless of Size

more seam welds on one surface. Momentary pressure on the foot switch initiates welding cycle to form the parallel seam welds. Welding wheels, lower electrode, transformer, etc. are water cooled. Movable table is actuated by air; hydraulic cylinders act as dash pots to insure uniform and smooth travel.

•

Clothes Dryer

Automatic clothes dryer. **Westinghouse Electric Corp.**, Mansfield, Ohio.

Appliance dries clothes by a tumbling process in fan-driven heated air. (The dryer is a companion piece to the Laundromat and is identical in size and shape. It is reported that tumbling the clothes results in a fluffing action which makes it unnecessary to iron certain flat pieces.)

•

Limit Bridge

Model "LB-3" resistance limit bridge: used to check one ohm to three megohm resistors. **Industrial Instruments, Inc.**, 17 Pollock Ave., Jersey City 5, N. Y.

A modified Wheatstone bridge, which has high and low limit dials that cover a range of plus or minus 11 percent in 0.1 percent steps, uses a built-in galvanometer. In normal operating position the zero on the galvanometer scale acts as the reference point. Relays provide for fast operation, either from a switch on the panel or one on the test fixture. External resistance standards are required.

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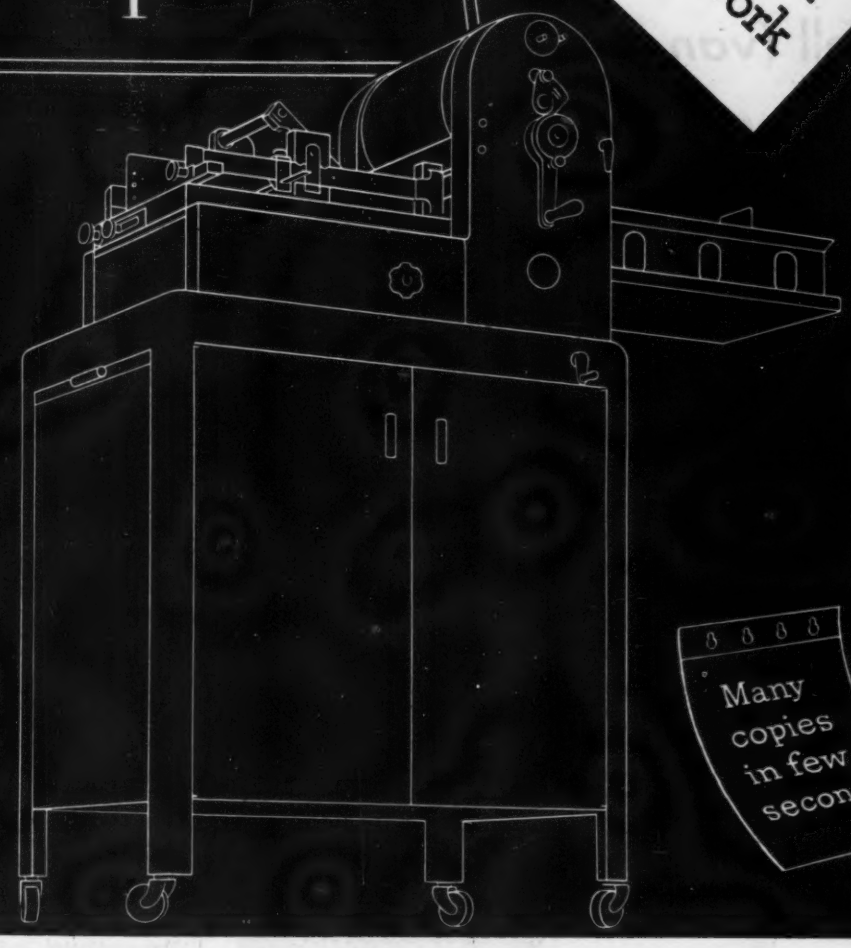

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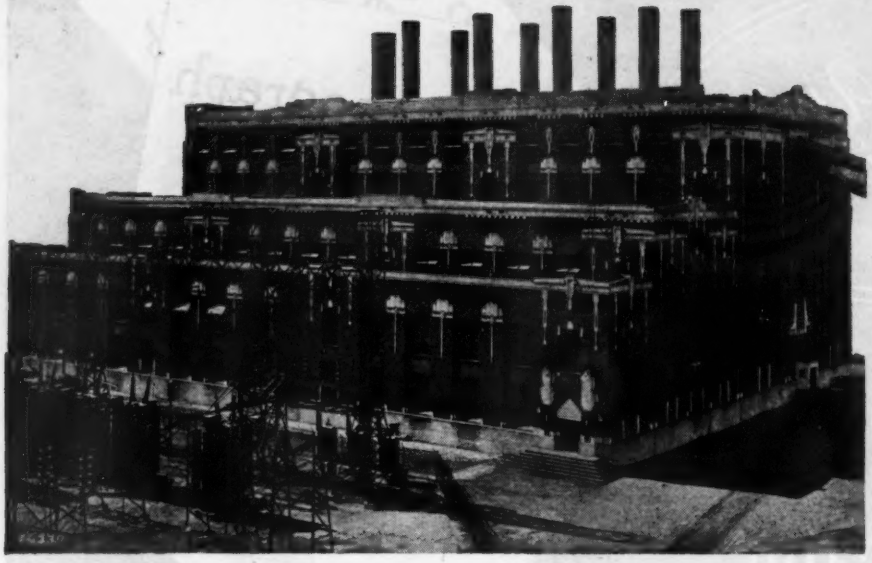
For the modern POWER PLANT



Buell (van Tongeren) Dust Recovery Systems

• THIS POWER PLANT has a total generating capacity of 111,000 KW, including 37,500 KW from a new turbo generator served by a 400,000-lb.-per-hr. Combustion Engineering boiler. The boiler, fired with pulverized coal, develops steam at 875-lb. pressure and 900° F.

The 32 Buell (van Tongeren) cyclone flue dust collectors installed with this new boiler have proven satisfactory under actual operating conditions, giving high collection efficiency and requiring no maintenance during the two years they have been in operation.

Power plant engineers are invited to write for the interesting, illustrated book—"The Buell (van Tongeren) System of Industrial Dust Recovery." Ask for Bulletin G-842.

BUELL ENGINEERING COMPANY, INC.
70 Pine Street, New York 5, N. Y.
Sales Representatives in Principal Cities

buell
DUST RECOVERY SYSTEMS

DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

TECHNICAL LITERATURE

Electronics—"Introduction to Electronics" is a 20-page booklet which contains a discussion on the fundamentals of conversion and control of electric power as an introduction to the subject of electron tubes. The discussion of tubes is divided into two parts—vacuum and gaseous. It is written to act as a guide for application engineers. Line drawings, sketches and curves are used to amplify the text. Copies of booklet E6358 may be obtained from Allis-Chalmers Mfg. Co., 658, Milwaukee 1, Wis.

Personnel—A 12-page booklet, entitled "ILG Welfare Club", contains the history and development of the company's policies and personnel practices. Copies may be secured from ILG Electric Ventilating Co. Chicago, Ill.

Fire Protection—Safety engineers, fire protection officials, and other executives concerned with fire protection are offered an instructive folder by the General Detroit Corp., 2270 East Jefferson Ave., Detroit 7, Mich. Information printed on the inside of the folder, which will fit all standard file draws, includes sketches of the five principal types of extinguishers, classes of fire for which each is recommended, Underwriters' Laboratories rating of each, and other data on the operation, recharging and effectiveness of the extinguishers.

Radio—A "Tube Interchangeability Chart", an 8½ by 11¼-in. card, listing approximately 300 transmitting tube type numbers (for ease in selection) is available from the Amperex Electronic Corp. 25 Washington St., Brooklyn 1, N. Y.

Measurement—Booklet 98-Y entitled "Theory of the Rotameter" contains a history of development of the area-type flow meters and an explanation of how the effects of viscosity and density in flow rate measurement are overcome. Copies may be obtained by writing Fischer & Porter Co., 9112-A County Line Road, Hatboro, Pa.

Equipment—Underwriters Laboratories, Inc., 161 Sixth Ave., New York 13, N. Y. has issued a revised "List of Inspected Electrical Equipment" which includes all listings up to May 1, 1945.

Unfreezing—Bulletin U-212 describes the characteristics of an electric salt bath furnace coil used to unfreeze Upton salt baths. The coil consists of a Chromel-A element, is connected to two mild steel bars and is operated in conjunction with a transformer. Copies are available from Upton Electric Furnace Division, 7450 Melville St., Detroit 17, Mich.

Iron—A 24-page booklet entitled "Armco Magnetic Ingot Iron for D.C. Applications" describes the iron and its advantages in certain applications. One section contains data on the effect of strains on magnetic properties, hot and cold working, machining operations with aid of standard tools and accepted methods of welding. Also includes tables making selection of electrodes easier. Copies may be obtained from American Rolling Mill Co., Middletown, Ohio.

Melamine—A 24-page booklet describing many applications of chemical melamine may be obtained from American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.

Manual—The story of the traction-type dynamometer and the increasing number of uses which are being found for it in testing and weighing procedures is presented in manual form. Copies are available from W. C. Dillon & Co., Inc., 5410 West Harrison St., Chicago 44, Ill.

Small Units Achieve High Rate of Heat Transfer

. . . thanks to unique design and use of COPPER

"Heliflow" Coolers and Heaters are made in a range of sizes. From left to right is shown a progression from smallest to largest unit. View at right shows coils of Anaconda Copper Tubes being installed in Heliflow casing.

ACCORDING to the Graham Manufacturing Company, Inc., New York, these "Heliflow" Coolers and Heaters possess an exceptionally high rate of heat transfer, are unusually compact, easy to clean, and are designed with a minimum number of joints.

They have an extremely wide range of application, including such uses as lube oil coolers, boiler and evaporator blow-down heat exchangers, feed water and water supply heaters, fuel oil heaters, and similar uses for which their capacity range of 1½ to 60 sq. ft. renders them suitable.

For most applications, "Heliflow" units are equipped with coils fabricated from Anaconda Copper Tubes. Where extremes of pressure, temperature, or other conditions demand extra strength or resistance to specific corrosive agents, copper-base alloy tubes are employed.

Anaconda Condenser and Heat Exchanger Tubes in copper and 10 different copper alloys are available for heat transfer requirements. Manufacturers and users of such equipment are invited to utilize the metallurgical knowledge and practical experience of our Technical Department. For detailed information, write for Publication B-2.

Keep Faith With Your Fighters and Yourself! BUY WAR BONDS FOR KEEPS

ANACONDA

Anaconda Heat Exchanger Tubes

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

NEWS ABOUT PEOPLE

Chattanooga Board Makes Operating Assignments

Announcement has been made by the Electric Power Board of Chattanooga (Tenn.) of new assignments on its operations staff.

E. C. Williamson, system operator, has been promoted to the position of superintendent of operations to succeed H. G. Williams, resigned. J. J. Renan,

E. C. Williamson

chief load dispatcher, will assume the duties of system operator. Supervision of the dispatchers and troublemen will be consolidated with the responsibilities of the system operator.

Mr. Williamson brings to his new position a broad background of engineering experience which eminently qualifies him for his increased duties. He entered the utility field with the Buffalo and Niagara Falls Light & Power Co. in 1910 and soon became substation construction foreman, serving as substation operator at times. He moved to Chattanooga in 1911, where he was appointed assistant superintendent of construction for the Chattanooga Railway & Light Co. In 1914 he was made chief engineer. In 1922, when Chattanooga Railway & Light was consolidated with the Tennessee Electric Power Co., Mr. Williamson was placed in charge of substation construction and operation for the entire company. In this position he was also in charge of the company's laboratory. He continued in this capacity until 1939 when he was placed in charge of substation and underground maintenance for the Electric Power Board of Chattanooga. Later that same year he was made system operator, the position he held until his recent promotion.

Mr. Renan also was connected with the old Chattanooga Railway & Light Co., at first in the substation construction department and then as substation operator. Following the formation of Tennessee Electric Power Co. Mr. Renan was transferred to the load dispatcher's office of that company. He was made chief load dispatcher in 1930 and in 1935 was given the additional duties of assistant to the superintendent of overhead lines. In 1939 when the Electric Power Board was formed he was made chief load dispatcher.

•

Dr. Millikan Retires

Dr. Robert A. Millikan, administrative head of California Institute of Technology, has retired. He had served as chairman of the executive council of the institute and as chairman of the Norman Bridge Laboratory of Physics since 1921 when he went to Pasadena, Calif., following 25 years as professor of physics at the University of Chicago. In 1923 he was awarded the Nobel Prize in physics as a result of his isolating and measuring the charge of an electron.

Although retiring from active administrative duties, he will continue as vice president of the board of trustees and will assist James R. Page, board president, in public relations and institutional development. He plans to devote much time to his own research and writing.

•

▶ HENRY H. COVINGTON, assistant manager in the Winchester district of the Northern Virginia Power Co., controlled by the Potomac Edison Co., before entering the Army Air Corps, has received his discharge and has been appointed Potomac Edison's air conditioning and heating supervisor.

De Kiep Joins Electric Machinery Mfg. Company

Electric Machinery Mfg. Co., Minneapolis, Minn., has announced the appointment of James De Kiep as chief engineer in charge of electrical and mechanical design and development.

Mr. De Kiep was formerly manager of the a-c motor engineering department at Westinghouse Electric Corp.,

J. DeKiep

East Pittsburgh. He is an electrical engineer graduate of the University of Michigan, has had extensive experience in the design of rotating electrical machinery, and has written several technical papers including a recent survey on the application of Silicone insulation to electric motors.

•

▶ F. O. MILLER, electrical engineer of Birmingham, Ala., has been named manager of the electric utilities department of Johnson City, recently organized upon the acquisition by the city of the utility properties formerly belonging to the East Tennessee Light & Power Co. A graduate of the Alabama Polytechnic Institute, Mr. Miller has been connected with the Alabama Power Co. since his graduation. During the 17 years of his association with the Alabama utility, he has worked in numerous departments and has received experience in all phases of electric utility work.

▶ C. P. STAAL, comptroller of the Southern California Edison Co., has retired from active service with the company after 41 years in the California electrical industry. He joined the San Joaquin Light & Power Corp. in 1905, going to the Pacific Light & Power Corp. in 1914. He was auditor for Pacific Light & Power when the company merged with the Southern California Edison Co. in 1917, and remained as auditor for the

Continental-Diamond

fabricated NON-metallic parts that fit

Pictured are two C-D DIAMOND Vulcanized FIBRE parts that were made from sheet stock . . . blanked out, smooth shaved, drilled and formed . . . to customers' blueprint.

KS-45

ON modern assembly lines, parts must fit! Economical production depends on rapid assembly of units. C-D fabrication methods are engineered to maintain dimensional accuracy just as all C-D products are engineered to meet specific electrical, mechanical and thermal problems.

Manufacturers who demand high standards in needed properties to insure unfailing product performance . . . and who also must have accurately fabricated parts to meet assembly line production problems . . . will want to investigate C-D NON-metallics.

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DILECTO—A Laminated Phenolic.
CELORON—A Molded Phenolic.
DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.
HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE
VULCOID—Resin Impregnated Vulcanized Fibre.
MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

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Established 1895 . . Manufacturers of Laminated Plastics since 1911—NEWARK 15 • DELAWARE

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PENETRAY

Reduced glare is an important reason for your selection of a Specific Near Infra-red source. Next, for baking, drying and evaporating, a radiant source peaking between 13,000 and 14,000 Angstrom Units is most desirable. These are two definite reasons for your use of Penetray.

Penetray production is unusually costly because of filament and construction detail. This, in our opinion, is necessary to a quality product. Lamp life and efficiency is imroved - resistance to vibration being maximum. A nonex arbor protects against softening of glass and resulting distortion of filament due to sagging. Radiant energy is emitted in both the vertical and horizontal. Honestly now, don't you want to know more about this new product and the prospect of improved results?

INFORMATION ON REQUEST - WITHOUT OBLIGATION

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VERD-A-RAY CORPORATION TOLEDO 5, OHIO

Edison Company. Thirteen years later he became general auditor, and was appointed comptroller in 1939. For many years a national leader in the utility accounting field, Mr. Staal was active in earlier days in the establishment of utility classification of accounts.

•

Utah Power Co. Appoints New Division Managers

Two promotions in the Utah Power & Light Co. organization have recently been announced.

R. R. Rowell, formerly Preston, Idaho, division manager, has been made Ogden, Utah, division manager succeeding the late George L. Ellerbeck and Joseph E. Cushman, formerly Rexburg, Idaho, division manager, has been named to succeed Mr. Rowell at Preston.

First employed by Utah Power & Light Co. in 1922, Mr. Rowell has served as hydro-electric station operator, traveling maintenance engineer; Rexburg, Idaho, division superintendent; commercial superintendent of the Western Colorado Power Co., a subsidiary, and division manager at Preston since 1937.

Mr. Cushman has been with the company since 1912, becoming district representative at Midvale, Utah, in 1932; division superintendent at Rexburg, Idaho, in 1929; Ogden division superintendent in 1939 and Rexburg division manager in 1941.

•

► M. C. McKay, engineer of station construction for the Pacific Gas & Electric Co., retired in July after 37 years of service with the utility. He has been succeeded by Arthur J. Swank, formerly assistant engineer. In the P. G. & E.'s employ continuously since 1923, Mr. McKay previously was associated with the Oakland Gas, Light & Heat Co. (which later became part of the P. G. & E. system). In 1903 he was resident engineer and had a hand in designing the plant of the Vancouver, B. C., Power Co. at Lake Buntzen, at that time the largest hydroelectric installation in the West. In recent years he has taken an important part in the building of many P. G. & E. plant installations. Mr. Swank, a graduate of the University of California in electrical-engineering, has been in the company's employ since 1919.

► Carl Jeerings, farm service supervisor of the Rochester Gas & Electric Corp., has been made chairman of the operating committee of the New York State Farm Electrification Council. The Council, under the Chairmanship of

"Flexitallic"...

REG. U. S. PAT. OFFICE

Flexitallic C-G (Compression Gauge) gaskets illustrated are available for all temperatures and pressures including the 2500 ASA flange standards.

THE SOLUTION TO 1001 GASKET PROBLEMS

When Flexitallic originated resilient spiral-wound gasket construction over a third of a century ago, working pressures ranged from 150 to 300 lbs. Today, pressures of 1500 lbs. (and even 2500 lbs.) are not uncommon. Extremely high temperatures and difficult conditions involving liquids, gases, or chemicals are frequently encountered—yet, through a constant process of development, Flexitallic has solved each new problem as it arose—and has anticipated many of them. No other company has concentrated research and engineering so fully on one type of gasket construction. None other can match Flexitallic in offering a service geared to the most exacting of today's demands.

High or Low Temperatures

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High or Low Pressures

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Liquids, Gases, or Chemicals

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Specifically designed for actual working conditions

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All types and shapes for all pipe flanges and pressure vessels

Given the simple necessities of adequate seating surface and bolting, there is no gasket problem Flexitallic can't beat!

FLEXITALLIC GASKET COMPANY • 8th & BAILEY STREETS • CAMDEN, NEW JERSEY

ORIGINATORS OF THE SPIRAL-WOUND GASKET — SPECIALISTS IN SPIRAL-WOUND GASKETS EXCLUSIVELY FOR OVER A THIRD OF A CENTURY

Matched Performance of brushes MAKES MOTORS BEHAVE

To get the most work out of d.c. and slip-ring motors and generators, equip them with SPEER Carbon Brushes. They make motors BEHAVE, because every SPEER brush is *matched*—mechanically and electrically—to the service characteristics of the machine it's sold to serve.

More and more motor users are turning to SPEER brushes for utmost freedom from burning, overheating, sparking, excessive wear, energy losses, and other brush troubles that decrease operating efficiency, cause extra maintenance.

You have *double* assurance of matched performance from SPEER brushes. First, because SPEER has made a specialty of matching brushes to machines for nearly 50 years. And second, because in SPEER'S all-inclusive line of standard and special carbon, graphite, electro-graphite and metal-graphite brushes, there is the grade that will deliver peak performance, fewer brush renewals and less maintenance on any application.

For SPEER brushes matched to the performance of your motors, see your supply house or electrical contractor—or write direct for Brush Data Forms. 8002

SPEER CARBON COMPANY ST. MARY'S, PA.

CHICAGO • CLEVELAND • DETROIT MILWAUKEE • NEW YORK • PITTSBURGH

Royal-ettes

#19 in a series of informative letters from a producer of Power Switching Equipment

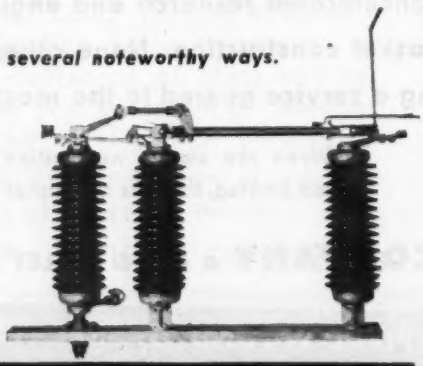
PLUS VALUES IN SWITCHES

● Robert Browning once wrote something to this effect: "There is nothing in a diamond that is not found in the lowliest piece of coal, but in form and effect how widely they differ!"

The Type VVL gang operated switch described on pages 162 to 164 and 188 to 190 of the Royal catalog which, by the way, is yours for the asking, is made of copper, copper-bearing alloys, and steel. So is every other competitive switch and they are all pretty good.

The Type VVL differs in several noteworthy ways.

1. The contacts at both hinge and contact ends are a unique high-pressure point contact design. This represented enough design progress to be patented.
2. The switch opens by direct lift. This avoids all complicated blade actuating mechanisms that have to be shunted.
3. Direct path for current flow, from terminal to terminal.
4. All braid shunts have been eliminated.
5. This simplified design reduces parts and hazards.



ROYAL ELECTRIC MFG. CO. 619 E. 40th Street CHICAGO 15, ILL.

Dean William I. Myers of the College of Agriculture at Cornell University, includes a representative of the Public Service Commission as well as representatives of the sponsoring public utilities. Professor C. N. Turner of Cornell has the active direction of the work. Mr. Jeerings is also active on committees of the American Society of Agricultural Engineers and the Edison Electric Institute.

•

New Appointments Made by Westinghouse Lamp

Appointment of three men to key positions in the Westinghouse Lamp Division, Bloomfield, N. J., has been announced by Ralph C. Stuart, vice-president in charge of the company's lamp and lighting divisions.

Henry B. Ahlers has been named as assistant on Mr. Stuart's staff; Dr. Albert Brann was named manager of the division's specifications and standards department, and Paul B. Tully was appointed assistant manager of lamp manufacturing. All three will make their headquarters in Bloomfield.

Mr. Ahlers, who joined Westinghouse in 1924 in the accounting department of the lamp division's New York office, has been factory accountant since 1943. Dr. Brann, who has been a specifications and standards engineer since 1935, joined Westinghouse in 1918 as a chemist. Mr. Tully, who has been supervisor of lamp engineering and design since 1938, joined Westinghouse in 1923 as a student engineer.

•

▶ KEN MAGERS, for 20 years advertising and publicity manager of the Cincinnati Gas & Electric Co. and other Columbia System organizations of the Cincinnati group, has joined Foster & Davies, Inc., Cleveland advertising agency. Previously, he had served as advertising manager of companies in both the consumer products and heavy industry fields. Mr. Magers is a past-president of the Public Utilities Advertising Association. As publicity director of the Cincinnati Electrical Association, he was responsible for the success of many co-operative electrical promotion campaigns and expositions. Another of his Cincinnati responsibilities was handling publicity for the Cincinnati Pure Food Show and Times-Star Cooking School, which was, until the war, a key element in the Cincinnati area lighting and appliance activity.

▶ LLOYD W. EDWARDS, formerly manager of the Mountain States Power Co., Casper, Wyo., has been transferred to the company's headquarters office at Albany, Ore. Mr. Edwards has been

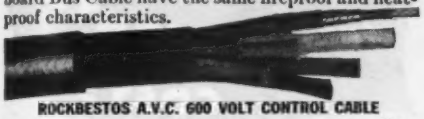
For Severe Conditions

Permanently Insulated ROCKBESTOS Wires, Cables and Cords

ROCKBESTOS A.V.C. 600 VOLT SWITCHBOARD WIRE
(National Electrical Code, Type AVB)

Sizes No. 18 to No. 4/0 AWG with varnished cambric and impregnated asbestos insulation and gray, black, white or colored flameproof braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A.V.C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.



ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

In one to 19 conductors with individuals insulated like Motor Lead Cable, cotton braid covered and cabled with an asbestos braid over all. Standard strandings AWG No. 12—19/#25 and No. 9—19/#22. Other strandings on order.

Designed for use in equipment requiring a multi-conductor control cable capable of withstanding high temperatures, this cable is widely used in the control systems of electric cranes manufactured for use in steel mills. The insulation is unaffected by heat, corrosive fumes, oil or grease and has ample moisture resistance.

ROCKBESTOS FIREWALL RADIO HOOKUP WIRE

Sizes No. 22 to 4 AWG in 1000 volt rating, and No. 12, 14 and 16 AWG in 3000 volt insulated with high dielectric synthetic tape, impregnated felted asbestos and covered with color coded lacquered glass braid.

The first small diameter heat and flame resistant high-dielectric hookup wire, designed in 1937 and approved by the C.A.A. for use in airborne radio equipment. Widely used since in automotive and ground communications systems, electronic devices and apparatus. Operating temperature range 125° C. to minus 50° C. Ideal for small motor, coil, transformer and dynamotor leads and bunched wiring in compact apparatus. Also with tinned copper shielding braid and in twisted pair, tripled or cabled multi-conductor constructions.

ROCKBESTOS MULTI-CONDUCTOR FIREWALL INSTRUMENT CABLE

This unusually small diameter, light weight, high-dielectric 3 conductor No. 26 AWG cable, with individuals insulated like our Radio Hookup Wire, was designed for an electronic device in which three No. 22 AWG single conductor aircraft wires proved too bulky. It is made to a nominal diameter of .125" (smaller than a 14 AWG single conductor 1000 volt Rockbestos Firewall Radio Hookup Wire). Also in 4 and 5 conductor constructions.

ROCKBESTOS THERMOSTAT CONTROL WIRE

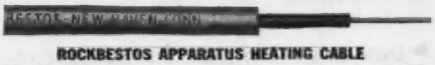
Sizes No. 14, 16 and 18 AWG in two to six conductors with .012", or .025" or (for 115 volt service) .031" of impregnated felted asbestos insulation and steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal, and temperature control systems. Lifetime heatproof, fireproof insulation and rugged steel armor give troubleproof circuits.

ROCKBESTOS ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of Rockbestos A.V.C. Motor Lead Cable will complete the failure-proofing.



ROCKBESTOS APPARATUS HEATING CABLE

No. 19 AWG nickel-chromium resistance wire insulated with .040" of impregnated felted asbestos and covered with 4/64" waterproof lead sheath.

Manufacturers of photographic developing tanks, dry print developing machines, candy making equipment, soil heating cable kits and other devices requiring controlled distribution of mild heat can use this pliable heating cable to advantage. Also useful in preventing freezing of water pipes and congealing of oil, grease, ink, paint and sluggish fluids in conveyor pipes.

ROCKBESTOS 300 VOLT HEAT RESISTING FIXTURE WIRE
(Underwriters' Type AF)

Sizes No. 10 to 18 AWG stranded plain copper conductor insulated with black or white impregnated felted asbestos—with or without braid.

Rockbestos asbestos insulated fixture wires, approved by the Underwriters' Laboratories, are ideal for lighting fixture wiring because their heat resistant insulation will not bake out under the high socket temperatures developed in modern fixtures. Also used for small motor leads, miniature switchboards, business machines, radios, etc.

ROCKBESTOS ALL-ASBESTOS APPLIANCE LEAD WIRE

Sizes No 8 to 20 AWG solid or stranded copper, monel or nickel conductors insulated with .031" or .040" of impregnated felted asbestos in black, white or colors.

Whether you make waffle irons, hot-plates, small motors, ranges, water heaters, radios, ovens or blueprint machines, we can give you an asbestos lead wire made to fit the electrical and mechanical requirements of your product.

ROCKBESTOS ALL-ASBESTOS 600 VOLT FLEXIBLE CORD

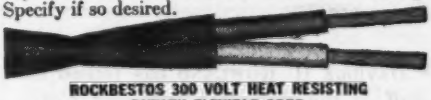
Sizes No. 10 to 18 AWG with two or three conductors insulated with impregnated felted asbestos and covered with a heavy asbestos braid.

This heavy duty heat-resisting flexible cord is ideal for high wattage lighting units, apparatus, floodlights, etc., that are used in hot spots or develop heat in operation. For moisture resistant type specify the Rockbestos A.V.C. construction described below.

ROCKBESTOS A.V.C. 600 VOLT FLEXIBLE CORD

Sizes No. 10 to 18 AWG with two or three conductors insulated with impregnated felted asbestos, varnished cambric, felted asbestos and covered with a heavy impregnated asbestos braid.

For applications such as mentioned above in which heavy duty, high-dielectric, heat and moisture resistant flexible cord is required we recommend this construction with individual conductors insulated exactly like Rockbestos A.V.C. Motor Lead Cable. Approved for lighting applications, with polarized conductors, by Underwriters' as Style V flexible cord under a 300 volt rating. Specify if so desired.



ROCKBESTOS 300 VOLT HEAT RESISTING DUPLEX FLEXIBLE CORD
(Underwriters' Type AFPD)

Sizes No. 10 to 18 AWG stranded plain copper conductors insulated with impregnated felted asbestos, polarized, twisted together and covered with a cotton braid.

This duplex heat resisting flexible cord is approved by the Underwriters' Laboratories for use in fixtures and is recommended for pendant types as the asbestos insulation will not dry out or crack at the socket. It provides protection against wire-failure, eliminates fire-hazard and gives permanent suspension as it does not deteriorate with heat or age. Also in twisted pair, tripled and triplex.

ROCKBESTOS A.V.C. 600 VOLT MOTOR LEAD CABLE
(National Electrical Code, Type AVA)

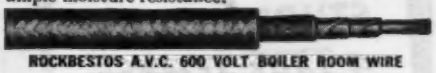
Size No. 18 AWG to 1,000,000 CM insulated with two walls of impregnated asbestos and a high-dielectric varnished cambric insert, with a heavy asbestos braid overall.

Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.

ROCKBESTOS A.V.C. 600 VOLT POWER CABLE
(National Electrical Code, Type AVA)

Sizes No. 18 AWG to 1,000,000 CM insulated with laminated felted asbestos, varnished cambric, and asbestos braid Other constructions for service voltages to 5000.

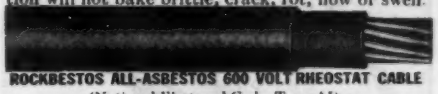
Use Rockbestos A.V.C Power Cable for the internal wiring and power leads of heat-exposed heavy electrical equipment and hot-spot wiring in conduit around boiler rooms, steam lines, furnaces, etc., as it withstands high temperatures and has ample moisture resistance.



ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE
(National Electrical Code, Type AVA)

Sizes No. 18 to 8 AWG insulated with varnished cambric, impregnated felted asbestos and asbestos braid. Sizes 6 to 4/0 have another wall of impregnated asbestos next to the conductor

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Its permanent insulation will not bake brittle, crack, rot, flow or swell.



ROCKBESTOS ALL-ASBESTOS 600 VOLT RHEOSTAT CABLE
(National Electrical Code, Type AI)

Sizes No. 18 AWG to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For flexible stranded conductor specify Rockbestos All-Asbestos Flexible Apparatus Cable. For solid conductor specify Rockbestos All-Asbestos Rheostat Wire.

A few of the National Electrical Code types (listed by Underwriters' Laboratories) and other constructions in the Rockbestos line of 125 different *permanently insulated* wires, cables and cords designed to give long-lived, dependable service in electrical products — all built to resist such wire-destroying hazards as heat, moisture, oil, grease, corrosive fumes and flame. For complete information or samples write to:

Rockbestos Products Corporation
102 Nicoll St., New Haven 4, Conn.

RESIST Heat, Moisture, Oil, Grease And Fumes WON'T Bake Brittle, Bloom, Burn or Rot

STURD-E GUARDED
PIKE POLE
●The automatic guard adds immeasurably to the safety of this pole—the point is covered when not in use—completely guarded against damage. When in use, the tubular sleeve slides back and reenforces the head, adding to the service life of the pole.
The spike is forged from best quality steel, heat treated and tempered for long life. Handles are select fir—sanded and lacquered—lengths regularly furnished ten to twenty feet. For maximum service life, economy, and value, specify
STURD E TOOLS
a TRUE TEMPER PRODUCT
Automatic Tubular Pike Pole guard is shown in the phantom view above. Extremely simple in operation, it gives positive protection to the point of the pike.
Distributed by
JOSLYN MFG. & SUPPLY COMPANY
Executive Offices
20 North Wacker Drive • Chicago, Illinois
Branches and Warehouses with Complete Stocks in Principal Cities of the United States

serving as chairman of the engineering section of the Rocky Mountain Electrical League. A. S. Anderson, regional manager of the G-E central station division, has been made chairman of the RMEL's engineering section to succeed Mr. Edwards.

► Don E. B. Corson, sales manager of the power factor division of the Cornell-Dubilier Electric Corp., has resigned from that position, and has established a consulting engineering practice in the field of capacitor application with offices in Rochester, N. H. A graduate of the Massachusetts Institute of Technology, Mr. Corson has specialized in this field for more than twelve years.

► Francis S. Root, district power sales engineer of the New England Power System with headquarters at Northampton, Mass., since early 1936, has retired after 36 years of service with the System utilities. He was graduated from Tufts Engineering School in 1896, also receiving an E.E. degree, and after serving with the Narragansett Electric Lighting Co., Providence, R. I., as a heating salesman was transferred to power sales. He served as power sales engineer for the Fall River Electric Light Co. for 16 years, spent three years with the Central Hudson Gas & Electric Co., Poughkeepsie, N. Y., and then rejoined New England Power, being stationed at Worcester and Boston until his transfer to Northampton.

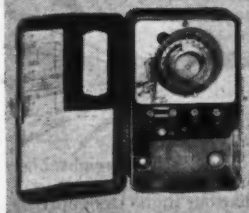
► A. L. P. Jezyk has been transferred from Salem, Mass., to Northampton, Mass., where he will serve as power sales engineer for the western district of the New England Power System. He is a graduate of Worcester Polytechnic Institute and joined the New England utility group in 1929 in construction work on transmission lines. Later he was an operator at Pratts Junction, Mass., substation, and in 1937 was appointed commercial sales engineer for the Mystic Valley district, near Boston. Since early 1941 he has been in charge of power sales for the Boston North Shore area.

► Davidge H. Rowland has joined the staff of the Porcelain Insulator Corp., Lima, N. Y., as ceramic research engineer. Prior to Pearl Harbor, he had been in the employ of the Locke Insulator Corp., where he served successively as electrical engineer, research engineer and chief ceramic engineer. It was during this period that he published a number of papers on high voltage porcelain, one of which "Porcelain for High Voltage Insulators", received an award from the American Institute

"Keep the cost down"... is a demand which manufacturers will soon again have to meet. During the war, industry has learned much about cutting cost through control of timed operations. Paragon automatic electric time control instruments not only help to lower costs, but also increase output... multiply manpower efficiency... and save precious hours . . . on countless jobs.

What is your time control need?

● PARAGON DESIGNS AND BUILDS UNITS FOR PRACTICALLY EVERY TIME CONTROL NEED



SERIES 300

General purpose, Telechron motor operated time switch, self-lubricating, for controlling signs, stokers, blowers, pumps, and other purposes. Accurate, rugged.

SERIES 2500

Manually preset interval timer, can be preset to perform a great variety of operations: to allow a given operation to continue for almost any predetermined time limit; and to close or open a circuit at the end of the preset time. Synchronous motor operated.

PARAGON ELECTRIC COMPANY
703 Old Colony Building Chicago 5, Illinois

Paragon Chicago
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1901

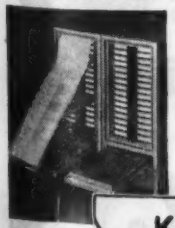
ORGANIZER OF "FACT-POWER"

HE frees utilities from the "drag" of idle facts

What is unusual about this man?

It's his ability to inject the priceless element of *control* into utility operating records . . . to give them "Fact-Power."

Unless they function effectively as controls, records are a mere history of customers, meters, appliance sales, etc. Such records *fail to indicate in themselves what action should be taken, and when.* Minor and major decisions alike must wait upon analysis of recorded facts.



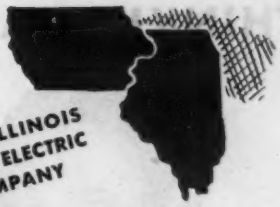
Sight analysis, made possible by the development of Kardex charting signal control, is saving valuable man-hours every day because officials called in the *Systems Utility Technician.* While providing the all-important control, this man also knows how to simplify and consolidate duplicated and overlapping utility records. He can design them to eliminate waste effort, house them for faster, easier reference, protect them from fire at the point of use.

Through experience interchanged with fellow-specialists in this field, he is familiar with the most modern public utility record-control techniques.

Inquire today through our nearest Branch Office, or write to us at New York.

KARDEX IS 1

. . . 1 among many methods and types of equipment from which the Systems Technician selects those best suited to individual needs.



IOWA-ILLINOIS GAS & ELECTRIC COMPANY

HE recommended centralizing customer records to improve service, reduce operating costs, furnish more effective controls. Kardex *Visible,* successfully used by many utilities, meets many requirements at Iowa-Illinois. Customer Service Record provides fast reference, speeds taking and handling of service orders, prevents errors, controls shut-offs. Customer History Record combines credit and collection data, makes collections selective, builds public good-will.

CONSUMERS POWER CO.

HE introduced economies through the Unit Plan of Bookkeeping. Consumers Power Co. accounts are divided into groups and each clerk is assigned one group of accounts. Meter books and ledgers are housed in Remington Rand Safe-Desks for *certified* 24-hours-a-day protection at point of use. The flow of work remains constant . . . peaks and delays are ended. Inquiries are routed and answered faster. Efficiency and accuracy are increased, clerical labor saved.

SAVANNAH ELECTRIC & POWER CO.

HE helped increase the utilization of equipment with Kardex. In adopting Kardex *Visible* Systems to obtain more effective record controls and lower operating costs, this company installed a Meter and Transformer History Record. This record provides easy, rapid reference to location and status of all owned meters, facilitating their maximum utilization. It also constitutes a valuable property record, protected from wear, loss and misfiling in Kardex "pockets."

SYSTEMS DIVISION

REMINGTON RAND

315 Fourth Ave., New York 10, N. Y.

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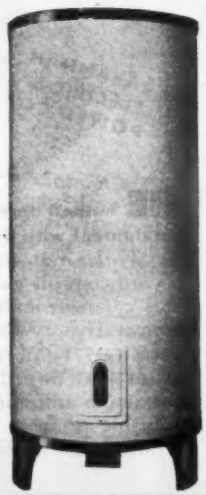
THINKING ABOUT

—THEN DON'T FORGET, MR. DEALER, THAT YOUR PROFIT DEPENDS ON SELLING A WATER HEATER THAT *GIVES* SERVICE—NOT ONE THAT *DEMANDS* SERVICE

In planning for profitable merchandising of water heaters it is vital that you select a heater that will give your customers long, completely satisfactory service and assure YOU freedom from costly repair and replacement expense. In choosing an electric water heater, here are three questions you will want answered:

1. IS IT A TRIED AND PROVED PRODUCT
   Answer: The Clark was the pioneer storage electric water heater more than twenty years ago and has been manufactured continuously ever since. Many of the original Clark heaters are still in daily service.
2. HOW WILL IT STAND UP IN HARD OR SOFT WATER?
   Answer: Because of the famous Clark "Lifesaver" element and its unique heating principle Clark heaters will give longer, more trouble-free service in the toughest kind of either scale-forming or corrosive water.
3. HOW ABOUT THE PEOPLE WHO MAKE IT — ARE THEY EXPERIENCED, DEPENDABLE?
   Answer: The McGraw Electric Company name on the Clark heater is your guarantee of honest value and fair dealing. Check it any way you like, you will find the name and product dependable.



A CLARK FRANCHISE FOR YOUR TERRITORY MAY STILL BE OPEN. WRITE FOR FULL DETAILS.

McGRAW ELECTRIC COMPANY
CLARK WATER HEATER DIVISION
5201 W. 65th Street, Chicago 38

CLARK
ELECTRIC WATER HEATERS
A Toastmaster Product

of Electrical Engineers. Previous to his connection with the Locke Insulator Corp. he was connected with Stone & Webster Corp. and the Western Union Telegraph Co. When war broke out, Mr. Rowland joined the staff of McConway and Torley Corp. of Pittsburgh as metallurgist and chief engineer, serving as a member of the cast armor development and operating groups which were formed for the interchange of technical data between the armor manufacturers and to establish liaison with the Ordnance Department.

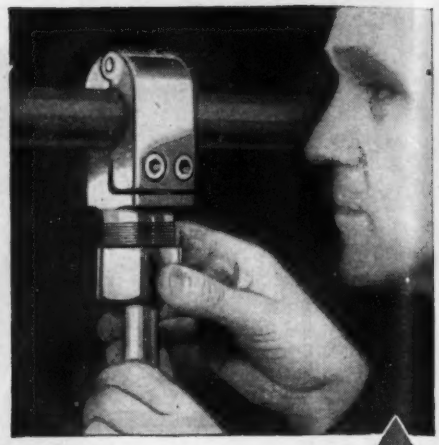
► BARRETT L. CRANDALL has been appointed director of public relations of the Society of the Plastics Industry, Inc., to succeed ALBERT PFALTZ, resigned. Mr. Crandall has been associated recently with a group of business leaders engaged in post-war planning for industry. Prior to that he was engaged in public relations and advisory work, serving private organizations and trade groups.

OBITUARY

► MINARD R. FREDERICKSON, assistant division manager of the Wisconsin Public Service Corp. at Wausau, died on July 7 in his fifty-fourth year. Mr. Frederickson became identified with Wisconsin Public Service in 1916 at Merrill, was transferred to Wausau in 1920 and in 1922 was made superintendent of operations at Tomahawk, serving until 1923, when he returned to Wausau as superintendent of its merchandising department. In 1925 he was appointed superintendent of public relations and safety and in 1932 he was placed in charge of the corporation's rate department. Since 1936 he had been assistant to the division manager. For many years Mr. Frederickson had been an active member of the Wisconsin Utilities Association.

► R. S. WILHELM, for 27 years connected with the Lake Superior District Power Co., Ashland, Wis., died on July 29 in Madison, following a long illness. He was 63 years of age. Mr. Wilhelm became identified with the light and power industry in 1912 as chief engineer for the Michigan Gas & Electric Co. Four years later he was made operating superintendent of that company. In 1918 he went to Ashland to become chief engineer of the Lake Superior District Power Co.'s power stations and was serving in that capacity at the time of his death.

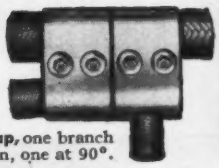
► ERNEST P. SMITH, 60, retired Fresno division manager of the Pacific Gas & Electric Co., died August 5 in Fresno. He had been associated with the Utility and predecessor companies for 37 years



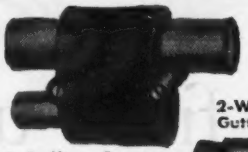
It's Easy to pick the right CABLE TAP— from the *Complete* line

You'll find the widest variety of parallel and 90° taps, combinations, and gutter taps — in a range of sizes up to 1,000,000 cm. Insulating Bakelite covers can be furnished for all types.

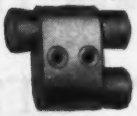
Single 90° Tap from main conductor.



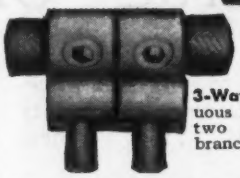
Comb'nation Tap, one branch parallel to main, one at 90°.



2-Way Gutter Tap.



Bakelite Covers can be furnished for all types of Penn-Union cable taps.



3-Way; continuous main and two separate branches.

Also a complete line of Service Connectors, Terminals, Tees, Straight and Parallel Connectors, Grounding Connectors, etc. — every good type of conductor fitting. And every one is accurately made, thoroughly tested — *dependable.*

PENN-UNION ELECTRIC CORPORATION ERIE, PA.

PENN-UNION
Conductor Fittings

(ADVERTISEMENT)

SYLVANIA NEWS
CENTRAL STATION EDITION

SEPT. *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Salem, Mass. 1945

ANOTHER SYLVANIA LIGHTING FIXTURE COMPETITION OPEN TO PUBLIC UTILITIES

The Judges

Eugene Burke—eminent industrial designer and architect. Architectural Design Instructor, University of Kansas. Specialist in store planning. Los Angeles, Calif.

R. J. Chapin—Superintendent of the Construction and Maintenance Division, Marshall Field and Company. Supervises fluorescent lighting installations. Chicago, Ill.

Lurelle Guild—nationally known industrial designer. Consultant and specialist in wide range of fields. New York, N. Y.

E. M. Strong—Professor of Electrical Engineering, Cornell University, Ithaca, N. Y. Author *Electrical Engineering, Basic Analysis* (1943).

Last year Sylvania Electric's fluorescent fixture design competition proved so stimulating to public utility people that the opportunity to again create a new load-building lighting unit was a natural outcome.

This time even *bigger awards* can be won. Five hundred dollars is to be awarded as the first prize, with the second, third, and fourth prize-winners receiving three, two and one hundred dollars respectively. In addition, eighteen fifty dollar prizes will be awarded.

Design a prize-winning fixture for the new Sylvania 8-foot Long-Slim fluorescent lamps—four in a fixture. Write today for your entry form and full particulars.

SEND FOR ENTRY BLANK

SYLVANIA ELECTRIC PRODUCTS INC.
Boston Street
Salem, Mass.

Gentlemen:
Kindly send me an entry blank with complete rules and information concerning the Sylvania Fluorescent Fixture Design Competition.

Name.....Position.....

Company .....

Company Address.....

City.....State.....

Send entry blank to:

Street and No.....

City.....State.....

SYLVANIA ELECTRIC

MAKERS OF FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

Clean INSTRUMENTS

in the **L&R** **INDUSTRIAL PRECISION CLEANING MACHINE**

Equipment also used to Clean · Rinse · Polish · Dry meters, jewels, crystals, radio tube parts, timing mechanisms and related units. Work basket measures 5½" ID x 3⅜" deep. Used by Army, Navy, airlines, over 400 industries, utilities, municipalities. Write for complete catalog data.

Clean BALL BEARINGS

in the **L&R** **Precision Ball Bearing CLEANING MACHINE**

For bearings measuring up to 2" OD. Machine combines famous rotary principle with new pressure cleaning mechanism to turn out scrupulously clean ball bearings. Used by Navy, major industries. Write for complete catalog data.

L&R

L&R MANUFACTURING COMPANY
577 Elm St., Arlington, N. J. • Chicago 2, Ill.

That *Extra* Reinforcing Thread Plate Assures Connections That Are Stronger And Last Longer

Sherman "Wedge-Grip Connector

Examine the above illustration, and you'll see that the screw in the Sherman Wedge-Grip Connector passes through *two* thicknesses of metal. The extra insert plate you see is a patented feature which *doubles* the thread strength — enables you to make connections that are twice as tight—twice as permanent.

Try the Wedge-Grip today. It's today's finest Solderless Connector for all small wire connections.

H. B. SHERMAN MFG. CO.

Battle Creek, Mich.

Sizes and Specifications

Part No.	Minimum Capacity	Maximum Capacity
SC-12X	2-20 Solid	2-12 Solid
SC-6X	2-12 Solid	2-6 Strand
SC-6	2-12 Solid	2-6 Strand
SC-4X	2-8 Solid	2-4 Strand
SC-2X	2-4 Solid	2-2 Strand

Part No.	Type Screw	Carton Quantity
SC-12X	Hex Head	200
SC-6X	Hex Head	100
SC-6	Plain Head	100
SC-4X	Hex Head	100
SC-2X	Hex Head	50

Sherman "Wedge-Grip" Connectors

prior to his retirement in March, 1944. Starting his utility career in 1907 with the former San Joaquin Light & Power Corp., Mr. Smith had advanced to the position of assistant to the general manager in 1926 when the corporation was merged with Great Western Power. He was then made assistant to vice-president and general manager A. Emory Wishon, and when Mr. Wishon became president in 1929, Mr. Smith became assistant to the president. In 1939 San Joaquin Power became part of the P. G. & E. system, and Mr. Smith served as assistant to vice-president Wishon until he was named Fresno division manager in 1943.

► HIRAM P. POWELL, formerly city manager of Griffin, Ga., and superintendent of the light and water department until two years ago, died at his home in that city on August 3. He was 65 years of age. Mr. Powell was a native of Blakely. He served as city manager at Griffin from 1933 to 1935 and was a former president of the southeastern division of the American Waterworks Association.

► WALTER S. DOLE, 77, consulting engineer for Federal Light & Traction Co. in New York until his retirement in 1933, died August 15 in Los Angeles, Calif. Mr. Dole has participated in construction of electric, gas and water facilities throughout the United States, Canada and Hawaii.

► EDWARD J. WALLIS, 71, first Pacific Coast manager of Western Electric Co., died August 16 in San Francisco, ending a career in the electrical industry that began in 1896. Following his association with Western Electric, Mr. Wallis was a manager of Graybar Electric Co. from 1926 to 1933.

► JESSE OLIVER, who participated in the formation of the old Merchants Power & Light Co., predecessor of the Memphis (Tenn.) Power & Light Co. in the early Nineties, died on August 11 at the age of 96. Mr. Oliver was born and educated in England, coming to this country in 1890.

► JUSTUS R. O'BRIEN, vice-president of the Ingersoll-Rand Co., New York, died on August 9 in his fifty-fifth year. Mr. O'Brien began working for Ingersoll-Rand in its branch office in Scranton, Pa. in 1917.

► RUSSELL E. HEDGES, assistant operating superintendent in the Riverhead, L. I., area for the Long Island Lighting Co., died on August 21 in his forty-fifth year.

Important Announcement to all Winch Users...

A COMPLETE NEW

AND IMPROVED LINE OF

GAR WOOD

WINCHES

ARE ON THEIR WAY

Watch for Additional Information in Future Gar Wood Advertising

GAR WOOD INDUSTRIES, INC., DETROIT 11, MICHIGAN

WINCH and CRANE DIVISION

WORLD'S LARGEST MANUFACTURERS OF TRUCK AND TRAILER EQUIPMENT

HOISTS AND BODIES • TANKS • ROAD MACHINERY • HEATING EQUIPMENT • MOTOR BOATS

MANUFACTURING MARKETS

Post-War Business May Reach '41 Level

In the first three post-war years following conversion, civilian peacetime business and employment at Westinghouse Electric Corp. promise to approximate 1941 levels, A. W. Robertson, chairman, has disclosed. Production in that year amounted to $369,094,000 and employment averaged 71,000, both figures being the highest in the company's history up to that time.

The estimated post-war business would be about double the average annual output of the company for the five pre-war years of 1936 through 1940.

Despite the fact that Westinghouse, at the end of the war, was employing 106,000 persons and had 25,000 former employees in the armed services, Mr. Robertson believes that there will be few employees left unemployed when the payroll goes down to 71,000. He based his opinion on the fact that many married women will return to their homes, other women will get married and leave, older employees are retiring, many men will leave to return to their regular peacetime work, and a considerable number of those in the armed forces will seek employment elsewhere. Increased business in new lines being established may send employment over the 71,000 figure.

•

Marmon-Herrington Co. Enters Transit Field

Marmon-Herrington, Inc., Indianapolis manufacturers of all-wheel-drive trucks has announced entry into the transit field with a line of trolley coaches produced under the direction of Charles Guernsey, newly-named vice-president. Initial orders have already been booked from Columbus and Southern Ohio Electric Co. and Indianapolis Railways, Inc. First production will be on 40 and 44 passenger models.

Mr. Guernsey, who will be manager of the new transit equipment division of Marmon-Herrington, has been associated for more than 20 years with J. G. Brill of Philadelphia as vice-president, directing engineering, sales and service department activities from 1936 until his resignation last September.

•

G.E. Plant to Make Air Unit Equipment Only

Manufacture of air conditioning equipment will occupy completely the Bloomfield Works of General Electric Co., Charles E. Wilson, president, has announced.

Mr. Wilson said engineering and manufacturing activities of the company's industrial control division, which have occupied about half the facilities of the plant, would be transferred to Schenectady. He added that the moves will require about two and a half years.

George R. Prout, general manager of the G. E. air conditioning department, estimated that demand for automatic heating, air conditioning and commercial refrigeration products will at least triple in the immediate post-war period.

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

ALLIS-CHALMERS MANUFACTURING CO. has appointed J. Warren Roberts branch manager in Chattanooga, Tenn. Mr. Roberts was formerly in the company's Atlanta district office.

SYLVANIA ELECTRIC PRODUCTS, INC. has named G. Dallas Rand Capitol Division manager, following the transfer of George R. Sommers to the Pacific Coast. Mr. Rand became assistant Washington manager early this year.

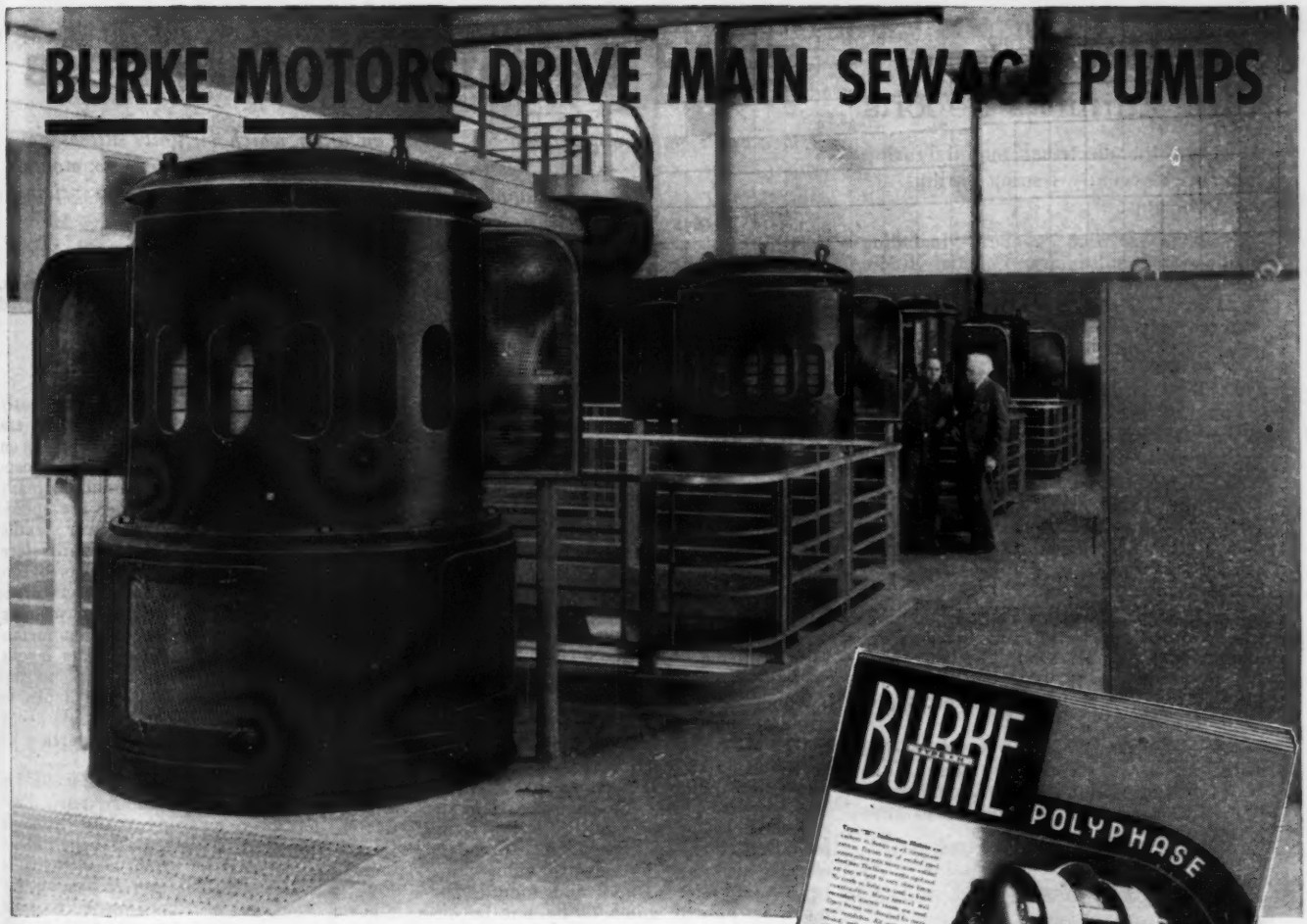
BORG-WARNER CORP., NORGE DIVISION, has named Dean Spencer southeast regional manager with headquarters in Atlanta, Ga., Mr. Spencer has been identified with the Norge line of household appliances for the past 14 years.

CANNON ELECTRIC CO., has appointed H. M. Linter & Son, 50 Warren St., New York, to represent the Schedule "B" and "C" products in a portion of New York State, Connecticut and New Jersey. Among the items are hospital signal systems, power connectors, laboratory and switchboard connectors, lamp sockets, etc. Covering the same schedules, Hart and Kugler, Park Square Building, Boston, Mass., have been appointed for the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and a portion of Connecticut.

RELIANCE ELECTRIC & ENGINEERING CO. has appointed two new distributors for Reliance a.c. and d.c. motors, generators and V-S motor drives. Standard Electric Motor Works of Detroit will supplement the activity of the company's district office in the busy automotive center. In Milwaukee, the C & G Sales & Engineering Co. will extend the service of Reliance's central western sales district.

TO ASSURE PERFECT SEALING—Marion Electrical Instrument Co., Manchester, N. H., has developed a new production vacuum checking apparatus to determine the effectiveness of its hermetically sealed indicating instruments. After sealing the instruments are submerged in glass jars of alcohol. A vacuum of 25 inches is drawn and the absence of air bubbles indicates perfect sealing

BURKE MOTORS DRIVE MAIN SEWAGE PUMPS



At Bowery Bay

NEW YORK CITY'S MODERN, ACTIVATED-SLUDGE, SEWAGE TREATMENT PLANT

BURKE MOTORS perform one of the most important functions in this new plant, that of driving the main pumps which deliver the raw sewage from the incoming lines to the treatment process.

Dependable - - efficient - - rugged describes these motors. Dependable - - for continuous trouble free service. Efficient - - for low operating cost. Rugged - - for long life.

These motors are - - Wound Rotor, adjustable, varying speed-vertical type with welded steel frames, oil lubricated ball bearings, solid shafts, drip proof covers and high ring bases. Stators are designed for operation on 208 volt, 60 cycle, 3 phase power supply.

The two motors in the foreground are 400 HP at 400 RPM while the two motors in the background are 200 HP at 600 RPM. Motor speeds are varied between 85 and 100 percent to maintain the most efficient suction head on the pumps. Motor speed controls are automatically actuated by a wet well float.

Burke builds all the type and sizes of polyphase induction motors from 1 to 1500 HP. We have a background of over 54 years of specialized motor experience enabling us to make sound recommendations. Write for booklet 101-A to get acquainted with Burke induction motors, and send us your next motor problem.

159 WEST 12th ST.

MOTORS 1 TO 1500 H. P. · GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA · *Since 1891*

Manufacturers Issue Earnings Reports

Among the electrical manufacturing companies recently issuing earings are the following:

SYLVANIA ELECTRIC PRODUCTS—Including wholly-owned subsidiary, Colonial Radio Corp., six months, earnings of $1,595,608, equal to $1.59 each on 1,005,000 common shares, against $849,108, or 84 cents a share, last year. Consolidated sales reached new high of $75,821,874, up 88 percent over $40,320,350 in 1944.

FORMICA INSULATION—June quarter, net income $117,491, or 72 cents a share, against $121,862 or 74 cents a share for March quarter this year.

ELECTRIC STORAGE BATTERY—Including wholly-owned subsidiaries, six months, net income $1,046,278, equal to $1.15 a share, against $1,004,747, or $1.10 a share last year.

CONTINENTAL-DIAMOND FIBRE—Including wholly-owned domestic subsidiaries, six months, net income, after $590,000 provision for taxes, was $219,004, compared with $193,688 in 1944; total sales, $6,542,736 against $5,818,211.

APEX ELECTRICAL MANUFACTURING—Net sales volume for six months ending June 30 reached record total of $15,174,000, three times the sales figure for the comparative period of the previous year.

•

Copperweld Celebrates Thirtieth Anniversary

On August 16, the Copperweld Steel Co., Glassport, Pa., celebrated its thirtieth anniversary. Copperweld has been honored with four Army-Navy "E" awards for its excellent performance in the production of wire for war purposes.

According to W. J. McIlvane, executive vice-president, the company is now spending more than a million dollars on a plant expansion and improvement program.

•

"At Your Service" Issued

A four-color booklet, entitled "At Your Service," describing the world-wide organization of Western Electric Export Corp. and its services to the motion picture industry abroad, has recently come off the press for distribution through the company's 100 branch offices and service points to producers and exhibitors outside the United States. In addition to an edition in English, the booklet will appear in Spanish, French and Portuguese. The main portion of the booklet points up the broad and varied experience of Western Electric and Bell Telephone Laboratories in the design and manufacture of electronic and communications equipment.

Field Reports on Business

Office of Price Administration has issued an order which virtually allows new manufacturers who expect sales to be less than $100,000 in the next six months to set their own prices. Mounting opposition to OPA's reconversion pricing policies in general is being noted in major industrial centers.

CHICAGO

Local radio and appliance manufacturers are getting off to a fast start on civilian production as is evidenced by a flurry of post victory announcements by various firms.

First home freezer for civilian use came off the assembly line last week at the Deepfreeze division of Motor Products Corp. Echophone division of Hallicrafters Co. says it's ready to begin a full-scale peace time program aimed at the home radio market. John Meck Industries, Plymouth, Ind., which terminated all war contracts recently, began production of radios last week and says that it expects to reach production of 2,000 sets a day shortly. First shipments will be made before mid-September.

Admiral Corp. has advised all its distributors to expect a limited number of radios within 60 days. Its announced expectation is to exceed its July-December quota of 16,000 refrigerators, but distributors have been told these must go into the government stockpile until the order impounding them is rescinded. Company officials also said that electric ranges will be available for display and sample purposes in limited numbers by mid-December. The company began production of a record-changer attachment for radios August 22 and announced that sizeable quantities will be coming off the line within 15 days.

War end estimates indicated that when Japan accepted surrender Chicago's electrical manufacturing industry (which includes electronics) was producing at an annual rate of $1,600,000,000, compared with $269,000,000 in 1939. This is the largest gain in production recorded by any local industrial group.

The Chicago area as a whole almost trebled its industrial production during the war years, compared with 1939, with only a 45 percent increase in the dollar value of its plant facilities, says the Chicago Association of Commerce.

NEW YORK

Retail trade rose last week as consumers bought more heavily to compensate for the victory celebration closings. Dollar value was well above "victory" week and moderately higher than that of a year ago. In the wholesale markets, retailers were following a policy of caution.

Civil engineering construction volume for the short week due to the "victory" celebrations totalled $22,990,000, according to reports to *Engineering News-Record*. The week's total compared with $49,135,000 for the preceding week, $37,309,000 for the corresponding week in 1944, and was 49 percent below the previous four-week moving average.

The week's construction brought 1945 volume to $1,225,799,000 for the 34 weeks, an increase of 2 percent over the $1,201,360,000 reported for the period in 1944. Private construction, $374,827,000, was 42 percent higher than a year ago, but public construction, $850,972,000, is down 9 percent due to the 17 percent drop in federal work. State and municipal construction, $206,390,000, is up 28 percent compared with last year.

NEW ENGLAND

New England's prospects for an early conversion to peacetime production are encouraging; much depends, however, on obtaining war materials. Backlogs of considerable proportions are on hand in many textile plants. Maine industries are speeding up plans for changing over textile plant production. Rhode Island mills face labor shortages with huge backlogs of orders to be filled, and its non-ferrous products and jewelry industry are priming plants for a large production when metals are available. Connecticut expects layoffs in its aircraft production centers to unsettle conditions for a time but looks to small tool, appliance, and metal goods production to take up a large portion of the employment slack.

An emergency contract for $769,891 for improvements at the Logan Airport, East Boston, has been awarded to B. Perini & Co., Framingham, Mass. Boston has at its immediate disposal for street improvements slightly over $3,000,000, and Massachusetts highway contracts will be awarded as soon as plans are approved for about $7,500,000 in new construction. Street lighting prospects are brighter. Modernization of stores in the retail district of Boston and its outlying suburbs is approaching boom proportions. Refrigerating installations are advancing as a result of a quick pickup in restaurant and market re-openings in Boston.

PACIFIC COAST

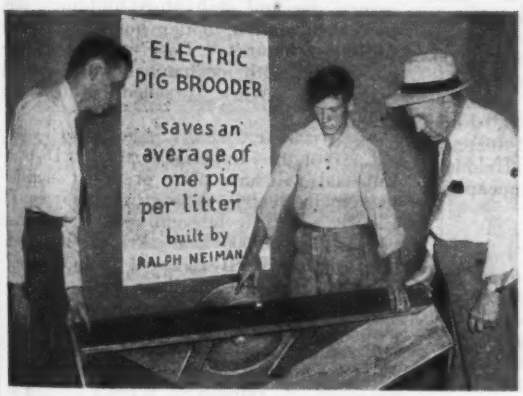
According to official WPB records the three Pacific Coast states rated third in the United States for value of war material orders placed between July, 1940, and May, 1944, or 8.8 percent out of a national total of 2-1/3 billions. Considerable marine electrical business resulted in major coast cities, but it will necessarily be cut to a small fraction of its former dimensions because of cancellations in merchant ships. All partially completed ships are expected to be finished this fall. Repair yards expect much reverse conversion—that is, from war to commercial service, but not until after troops are returned from Pacific area.

Prospective orders include a low bid of $86,312 for 88½ miles of REA transmission line in Bend or Eille region of Idaho; a series of radio range stations for CAA in California and Utah; and allotment of $255,000 for REA lines around Littletown, Colo. of which $67,500 is for acquisition of existing properties; and extensive fire alarm systems for Oakland army base and Dibble General Hospital at Palo Alto.

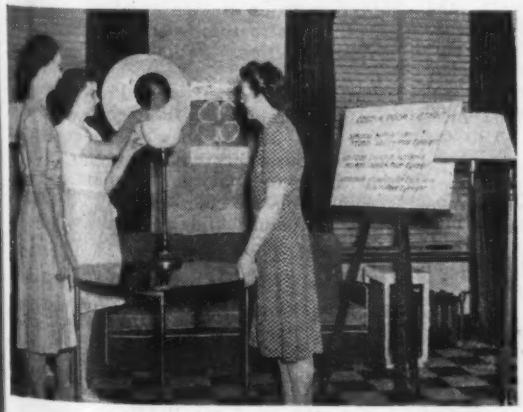
Many major system extensions are being reported from all parts of the territory, such as Idaho Power Co.'s 13,500-kw. hydro plant on Snake River near Hagerman; Pasadena's immediate 35,000-kw. expansion of its municipal system, costing $2,500,000; and allotment of $550,000 for REA system in McCone County, Montana.

"We start 'em early...learning better methods for using electricity"

SCHOLARSHIPS – Each year, Indianapolis Power & Light Company awards *$300.00 in College Scholarships* to Marion County 4-H Club members who have excelled in Better Methods Electric projects. Here, 4-H'ers Iva and Laura Monger explain their *better method* . . . for preserving food in an electric home freezer . . . to their mother, Mrs. Fred Monger.



EXHIBITS– Ralph Neiman explains the operation of his farm-built electric pig brooder to J. A. Mahr, Director of Rural Lines for I. P. & L, and E. L. Callahan, Marion County Vocational Agriculture Teacher. Ralph is entering his pig brooder in the 4-H Club Exhibit, conducted each year by the Indianapolis Power & Light Company. *$125.00 in cash* will be awarded to 4-H boys and girls who submit the best exhibits.



DEMONSTRATIONS– 4-H Club Member Leta Cunningham demonstrates her *better method* for home lighting to Miss Janice Berlin, Marion County Home Demonstration Agent, and Mrs. Harriet G. West, Home Service Director. Leta hopes to win one of the *33 Demonstration Awards, valued at $103.50*, offered annually by Indianapolis Power & Light Company.

Indianapolis Power & Light Company offers SCHOLARSHIPS AND CASH AWARDS in 4-H Club Better Methods Electric Contest in cooperation with Marion County Agricultural and Home Economics Extension Service

Indianapolis Power & Light Company believes in training farm boys and girls in the *wider use of electricity* on the farmstead. That's why this progressive utility annually offers Better Methods Electric Contest awards – *of a total value of more than $500.00* – to 4-H Club boys and girls in Marion County, Indiana.

These yearly awards consist of *College Scholarships* to 4-H boys and girls who have conducted the best Better Methods Electric projects – and *Cash Awards* to 4-H Club members who excel in Demonstrations and Exhibits.

"We start 'em *early* . . . learning *better methods* for using electricity", says J. A. Mahr, Director of Rural Lines, "because we want to help 4-H Club members become *better, more efficient farmers, tomorrow!*"

Sponsor a Better Methods Electric program of your own!

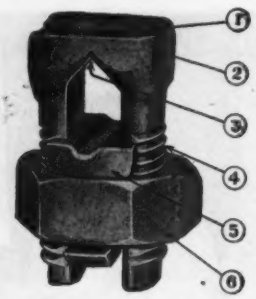
Send for "Here's Help to Increase Your Farm Load" which gives complete information regarding the 4-H Better Methods Electric Contest, including free promotional material.

Contact your nearest Westinghouse office, today—or write: Rural Electrification Section (EW-95), Public Relations Dept., Westinghouse Electric Corporation, Pittsburgh 30, Pa.

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

Tune in: JOHN CHARLES THOMAS—Sunday, 2:30 pm, EWT, NBC.
TED MALONE—Monday through Friday, 11:45 am, EWT, American Network.



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Conductor Connectors

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WHY THEY ARE BETTER:

(1). Broad, strong head, with size plainly marked. Sides of head have flat surface so wrench or pliers can grip tightly.

(2). 100% Pure Copper, Cold forged bolt of ample strength for all purposes. High copper content prevents corrosion and season cracking. All edges are rounded.

(3). Modified "V" shaped groove, holds wires in three point contact and prevents rocking or looseness.

(4). 85% plus, full thread, die stamped, insures full engagement in nut, hence high strength connectors. No sharp edges.

(5). "V" groove clamping jaw of cold forged, 100% pure copper. Flanged sides give greater bearing surface on nut, hence greater strength.

(6). 97% copper content, hard metal nut—strong as steel. Full thread engagement with bolt.

(7). Made in 9 sizes—6 sizes of cold forged copper as illustrated and 4 sizes of machined high copper content alloy.

Send for bulletin and free samples and convince yourself of their superiority.

With Nut Retainer

W. N. MATTHEWS
CORPORATION
ST. LOUIS, U. S. A.

Sales Opportunities

LOUISIANA—New Orleans Public Service, Inc., New Orleans, has plans in progress for new steam-electric generating station, estimated to cost about $6,000,000, with transmission lines, switching station and other operating facilities. Project will be carried out as soon as materials and equipment are available. Company also plans expansion in present Market St. power plant, with installation of new turbine-generator, high-pressure boiler and auxiliary equipment, to cost approximately $3,000,000.

PENNSYLVANIA—Pullman Standard Car Mfg. Co., Butler, plans expansion and modernization in local railroad car-building plant, including additional buildings, extensions in certain present units, with machinery and electrical equipment. Cost over $1,000,000. Work will begin soon.

MINNESOTA—City Water and Light Commission, Moorhead, George Duenst, plant superintendent, will receive bids until September 18 for extensions and improvements in municipal steam-electric power plant, including installation of new 3,000-kw. turbine-generator unit and accessories, boiler with rating of 55,000 lb. of steam per hr., stoker and auxiliary equipment. Fund of $712,000 has been authorized for program at recent special election. Helmick, Edeskuty & Lutz, Essex Bldg., Minneapolis, are consulting engineers.

NORTH DAKOTA—Light and Power Department, Cavalier, plans extensions and improvements in municipal power plant, including installation of new diesel engine-driven generating unit and auxiliary equipment. Estimates of cost are being made. Bids are scheduled to be asked soon.

OHIO—Frigidaire Division, General Motors Corp., Moraine City, Dayton, plans new one-story addition, about 250 by 880 ft., to cost approximately $1,200,000, with machinery and electrical equipment. Bids will be asked at early date.

WEST VIRGINIA—Monongahela Power Co., Fairmont, will carry out extensions in rural electric system in northern and central parts of state, including primary and secondary lines, power substation facilities, service connections, etc. This is part of a development program for rural electrification to be scheduled over several years, comprising service for over 10,000 homes, with total cost estimated in excess of $5,000,000.

TEXAS—Central Power & Light Co., Corpus Christi, has plans maturing for new addition to steam-electric generating station at San Benito, with installation of equipment for increased capacity.

NEW JERSEY—Standard Oil Co. of New Jersey, 26 Broadway, New York, N. Y., plans large petroleum research center at Bayway refinery, Linden, comprising a series of eight one and multi-story buildings, totaling 350,000 sq. ft. floor space, estimated to cost about $5,000,000, with mechanical and electrical equipment, and other technical apparatus. Company also will build a new research laboratory at refinery of Standard Oil Co. of Louisiana, Baton Rouge, an affiliated interest, to cost over $750,000, with equipment. Work on both projects will begin at early date, with first noted scheduled for completion late in 1946.

OREGON—California-Oregon Power Co., Medford, plans new radio transmitter station in vicinity of Lakeview, for intercommunication between that area and Klamath Falls, as well as in Tulelake district.

MICHIGAN—Public Lighting Commission, Detroit, has authorized plans for addition to Mistersky municipal steam-electric generating station on West Jefferson Ave., to cost approximately $500,000, with equipment for increased capacity. Smith, Hinchman & Grylls, Inc., Marquette Bldg., Detroit, is architect; Burns & Roe, Inc., 233 Broadway, New York, N. Y., is consulting engineer.

KANSAS—Loose-Wiles Biscuit Co., 1100 West Eighth St., Kansas City, Mo., plans large baking plant on 44-acre tract of land at Kansas City, Kan., consisting of several one and multi-story buildings, with power substation, boiler house and other utility structures. Cost estimated over $2,500,000, with mechanical and electrical equipment. Work is scheduled to begin soon.

CALIFORNIA—Imperial Irrigation District, Imperial, will have plans prepared soon for new hydroelectric generating plant in El Centro area, to be equipped for initial capacity of 20,000 kva. Project has been approved by WPB and will include extensions in transmission lines for connection with present high-tension system, switching station and other facilities. New station will replace a previously projected plant at Pilot Knob, All-American Canal, for which authority was refused by WPB a number of months ago.

MICHIGAN—GMC Truck & Coach Co., South Boulevard East, Pontiac, division of General Motors Corp., Detroit, has approved plans for one-story addition, about 360,000 sq. ft. floor space, for expansion in assembling department, with installation of machinery and electrical equipment for large increased output. Cost close to $1,750,000. This is the first of three new additions to be erected at plant, plans for other two structures being scheduled for early completion.

MINNESOTA—Light and Power Department, Sleepy Eye, will receive bids until September 18, for new steam-generating unit and accessory equipment for installation in municipal power plant, as per specifications on file. Pfeifer & Shultz, Wesley Temple Bldg., Minneapolis, are consulting engineers.

MISSOURI—Public Improvement Committee, City Council, Kansas City, has authorized plans for installation of an improved street-lighting system on about 50 miles of city streets. Work is expected to be placed under way as soon as materials and equipment are available.

MINNESOTA—Water and Light Department, Willmar, has plans under way for extensions and improvements in municipal steam-electric power plant, with installation of additional equipment for increased capacity. Pfeifer & Shultz, Wesley Temple Bldg., Minneapolis, are consulting engineers.

CABLEKRETE

Patented protective material for lead covered cables in manholes and tunnels. Resists fire, corrosion, moisture, arcing—adds life to cable. Shipped dry in 11 and 80 lb. bags. Just add water. A money and time saver for utilities. Send for complete information today!

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CABELUBE

The power cable lubricant that makes cable pulling easier and adds years to its life. Forms protective coating when cable is in place—inhibits corrosion of lead sheath. Packed in 50 lb. units. Send for complete information today!

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PREMAX

MARKERS THAT STAND THE WEATHER

Better visibility under all conditions — permanent —easily read. Investigate Premax Metal Markers for your lines.

Premax Products

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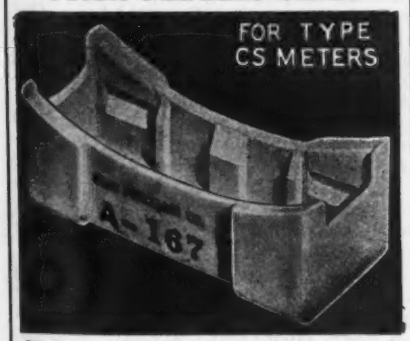
STAR METER SEAL



Eliminates meter tampering. Cannot be removed without mutilating. SEND FOR SAMPLE.

STAR PORCELAIN CO.

51 Muirhead Ave. Trenton, N. J.

AVOID CABLE ABRASION *with*

STAPUT FAIRLEADERS

"Rubbing at the duct mouth can be reduced by installing fairleaders on the cables at this point." — from Electrical World, May 29, 1943 (Cables —How to Make Them Last).

These non-corrosive alloy cable shields clamp in place to take wear at duct mouth. Easily and safely installed without interruption of service. Eliminate expensive repairs. Use STAPUT FAIRLEADERS. *Write for free catalog.*

Wm. B. Berry Co., 88 North St., Boston, Mass.

Recent Rate Changes

Lansing Board of Water and Electric Light Commissioners, Lansing, Mich., has announced an adjustment of electric rates to residential customers. The schedule, effective October 1, will bring higher rates for steam heat and for the larger water customers, but the cut in electric rates will mean a reduction of at least $3.60 annually for city residential customers whose monthly bills have been $1.70 or more, and at least $2.88 per year for customers outside city limits whose bills have been 90 cents a month or more. The new schedule "gives Lansing one of the lowest rates in the United States—even lower than in communities served by the TVA for residential bills amounting to less than $6.90 per month," said Otto E. Eckert, general manager of the board. Steam heating rates will be increased by eliminating the extra 10 percent discount given since January, 1933. This increase is made necessary by the increased cost of fuel and labor. The steam heat department has operated at a loss for the past two years. Change in water rates will affect only larger customers, mostly industrial and commercial, whose monthly bills are larger than $25. It is estimated that the rate revision will result in a reduction of electrical revenues for the Board of $100,000 a year. Steam heat revenues should increase $32,000, and water revenues $50,000, leaving a net revenue reduction of only $18,000 annually, Mr. Eckert said.

Blackstone Valley Gas & Electric Co., Pawtucket, R. I., has announced a reduction in electric rates which will result in an estimated saving of $133,000 annually to its 48,000 residential and 3,500 of the utility's commercial customers. The new rates take effect September 1.

Ohio Edison Co.'s residential and commercial customers in Springfield will benefit by lower rates, which became effective with reading of meters August 25. Utility officials estimate the saving to users of electricity will be $96,400 a year. The lower rates were authorized in an ordinance passed recently by the city commission.

Grays Harbor Public Utility District, Aberdeen, Wash., has removed restrictions on the all-electric rate to consumers. Under the new regulations, any consumer may contract for a minimum bill of $4.50 per month with the balance at the rate of ½ cent a kilowatt-hour. There will be no restrictions on the purposes for which the power is utilized. Heretofore, the consumers had to own an electric water heater, stove and refrigerator in order to be eligible for the all-electric rate.

Queens Borough Gas & Electric Co. has put into effect an electric rate reduction of $350,000 annually, according to Milo R. Maltbie, chairman of the New York Public Service Commission.

Pacific Gas & Electric Co., by changing zone classifications, has effected reduced electrical rates for nine California communities, it has been announced by the State Railroad Commission. The company requested the commission to change the unincorporated townships concerned from rural to zone five classification. Consumers in the suburban areas around Carmel, Salinas, Seaside, Napa, Arvin, Lamont, East San Jose, Redwood City and Stockton will benefit by a total savings of $49,000 a year. New rates become effective September 1.

A MASTER-LIGHT FOR EVERY NEED

360° REPAIR CAR SEARCHLIGHT

- REPLACES 2 SIDE LIGHTS!
- BEAM DOESN'T PASS DRIVER'S VISION TO BLIND HIM IN FOG.
- SUPER-POWERED YET WON'T BLIND APPROACHING DRIVERS BECAUSE MOUNTED HIGH.
- MAKE SUPERIOR FOG LIGHT.
- DRIVER OR PASSENGER CAN POINT BEAM AS EASILY AS POINTING A PISTOL.

SEND FOR NEW FREE EMERGENCY LIGHTING BULLETIN

CARPENTER MFG. CO.

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MASTER★LIGHT★MAKERS

EVERSTICK ANCHORS...

FOR SPEED IN INSTALLATION

The exclusive Everstick nut housing locks the Anchor firmly on the rod. This speeds up installation. Plates are so designed, that they expand easily into undisturbed earth, and extra holding power is achieved. Made of tough, rust-resistant malleable iron. Write for bulletin.

EVERSTICK ANCHOR CO.
FAIRFIELD, IOWA

HI-BOY SIGN

for Street and Highway Use

Will not blow over, leaving your men and the public unprotected.

Sign frame pivoted on each side allowing movement with varying wind pressures and full vision at all times.

Attractively and rigidly constructed; folds compactly for storing.

COMPLETE INFORMATION ON NEW BULLETIN EW-95

IPCO

Safety Equipment for all Industries

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2820 N. FOURTH STREET • PHILADELPHIA 33, PA.

Reduce Line Clearing Costs with Seymour Smith TELEPHONE PRUNERS

This powerful pruner cuts closer, is stronger than any other similar tool on the market. Can be operated in close tangled growth; cutting easily and cleanly branches up to 1½" in diameter. No trouble with spring breakage.

Here is the only pruner with the famous Seymour Smith "Center Cut" construction; safety catch to lock blade closed; one piece tempered tool steel blade; reinforced hook; extra long life spring; ball bearing pulley; highest quality chain; unbreakable iron head.

Designed by experts for experts; demanded by public utility companies everywhere, it will pay you to write for literature and prices.

SEYMOUR SMITH & SON, Inc.

901B Main Street
OAKVILLE, CONNECTICUT

REA Announces Allotments and Contracts

The Rural Electrification Administration has recently announced approval of allotments totaling $5,846,500 to 28 cooperatives in 20 states. The allotments, most of which will be used for line construction to extend electric service, include the following:

ALABAMA—Sand Mountain Electric Cooperative, Fort Payne, $350,000.

DELAWARE—Delaware Rural Electric Assn., Greenwood, $163,000.

FLORIDA—Tri-County Electric Cooperative, Inc., Madison, $50,000.

GEORGIA—Troup County Electric Membership Corp., La Grange, $85,000.

ILLINOIS—M. J. M. Electric Cooperative, Inc., Carlinville, $225,000.

INDIANA—Daviess-Martin County Rural Electric Membership Corp., Washington, $210,000; Warren County Rural Electric Cooperative Assn., Williamsport, $60,000.

IOWA—Woodbury County Rural Electric Cooperative Assn., Moville, $110,000.

KANSAS—Radiant Electric Cooperative, Inc., Fredonia, $375,000; Leavenworth Jefferson Electric Cooperative, Inc., Leavenworth, $155,000.

LOUISIANA—Concordia Electric Cooperative, Inc., Ferriday, $80,000.

MICHIGAN—Western Michigan Electric Cooperative, Scottville, $65,000.

MISSOURI—Crawford Electric Cooperative, Inc., Bourbon, $340,000; Mt. Vernon Electric Refrigeration Cooperative, Inc., Mt. Vernon, $7,000.

MONTANA—Sheridan County Electric Cooperative, Inc., Westby $413,000.

NEW MEXICO—Otero County Electric Cooperative, Inc., Cloudcroft, $125,000.

NORTH CAROLINA—Woodstock Electric Membership Corp., Belhaven, $155,000; Cape Hatteras Electric Membership Corp., Avon, $142,000, including $60,000 for generating facilities.

NORTH DAKOTA—Baker Electric Cooperative, Inc., Cando, $190,000.

OKLAHOMA—Cimarron Electric Cooperative, Kingfisher, $300,000.

SOUTH CAROLINA—Lynches River Electric Cooperative, Inc., Pageland, $432,000; Horry Electric Cooperative, Inc., Conway, $234,000.

TENNESSEE—Gibson County Electric Membership Corp., Trenton, $690,000; Sequachee Valley Electric Cooperative, South Pittsburgh, $570,000.

TEXAS—J-A-C Electric Cooperative Assn., Bluegrove, $190.000; McCulloch County Electric Cooperative, Inc., Brady, $70,500; Wood County Electric Cooperative, Inc., Quitman, $50.000.

VIRGINIA—Northern Neck Electric Cooperative, Warsaw, $10,000.

Construction Contracts Approved

COLORADO—Intermountain Rural Electric Assoc., Littleton, contract to A. B. Reither, Englewood, Colo., 19 miles of line; labor and materials, $18,564; engineer, Glenn R. Fickel, Denver, Colo.

DELAWARE—Delaware Rural Electric Assn., Greenwood, contract to Rockingham Construction Co., Harrisburg, Va., 36 miles of line; labor only, $16,843; engineer, Gibbs & Hill, Inc., New York, N. Y.

KANSAS—Central Kansas Electric Cooperative Assn., Inc., Great Bend, contract to E. A. Reither, Aiken, Minn., 232 miles of line; labor and materials, $240,201; engineer, Flora Engineering Co., Cheyenne, Wyo.

MINNESOTA—Stearns Cooperative Electric Assn., Melrose, contract to W. A. Patterson Co. and Ingolf Teigen, St. Paul, Minn., 105 miles of line; labor and materials, $101,189; engineer, United Engineering Service, Minneapolis, Minn.

MISSISSIPPI—Southwest Mississippi Electric Power Assn., Lorman, contract to Line Construction Co., Clarksdale, Miss., 16 miles of 33-kv. transmission line; labor and some materials, $29,020; engineer, Bowman & Bowman, Greenwood, Miss.

MISSOURI—North Central Missouri Electric Cooperative, Inc., Milan, contract to Miller Construction Co., Linton, Ind., 160.25 miles of line; labor and materials, $163,523; engineer, Frank Horton & Co., Lamar, Mo.

NORTH CAROLINA—Surry-Yadkin Electric Membership Corp., Dobson, contract to Rockingham Construction Co., Inc., Harrisburg, Va., 264 miles of line; labor and materials, $263,663; engineer, B. O. Vannort, Charlotte, N. C. Harkers Island Electric Membership Corp., Harkers Island, contract to Durham Electric Construction Co., Inc., Durham, N. C., 4 miles of 13.8-kv. delta transmission line; labor and materials, $6,245; engineer, L. E. Wooten, Raleigh, N. C.

OHIO—Buckeye Rural Electric Cooperative, Inc., Gallipolis, contract to F. W. Owens Co., Louisville, Ky., 187 miles of line; labor and materials, $246,318; contract to Killoren-Unthank Co., Appleton, Wis., 125.8 miles of line; labor and materials, $169,010; engineer for both projects, Ralph L. Woolpert Co., Dayton, Ohio.

OKLAHOMA—Southeastern Electric Cooperative, Durant, contract to J. Briscoe, Stillwater, Okla., 144 miles of line; labor and materials, $160,122; engineer, Midwestern Engineers, Tulsa, Okla. Cotton Electric Cooperative, Walters, contract to J & J Construction Co., Oklahoma City, Okla., 50 miles of line; labor and materials, $39,717; engineer, Midwestern Engineers, Tulsa, Okla. Southwest Rural Electric Assn., Inc., Tipton, contract to J & J Construction Co., Oklahoma City, Okla., 40 miles of line; labor only, $13,436; engineer, Midwestern Engineers, Tulsa, Okla.

SOUTH CAROLINA—Black River Electric Cooperative, Inc., Sumter, contract to Sumter Builders, Sumter, S. C., 7 miles of line; labor only, $1,841.

TEXAS—Lyntegar Electric Cooperative, Inc., Tahoka, contract to Reinhart & Donovan Co., Oklahoma City, Okla., 125 miles of line; labor only, $29,305; engineer, Price & Hawk, Lubbock, Texas.

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Winsted Hardware Gets Navy Irons Contract

A prime Navy contract, calling for the production of 20,000 electric irons to be used by service men and women in the United States Navy, has been awarded to The Winsted Hardware Manufacturing Co., Winsted, Conn., a subsidiary of Reeves-Ely Laboratories, Inc., New York.

The iron will be manufactured according to Navy specifications. Although not an exact duplicate of the electric iron produced by the Winsted company during the pre-war period, it is essentially the same.

LETTERS TO THE EDITOR

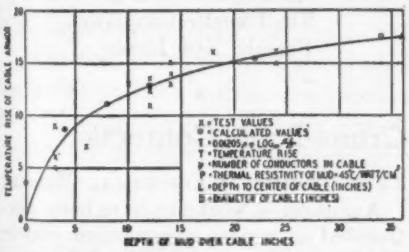
Thermal Conductivity of Mud

To the Editor of ELECTRICAL WORLD:

We have noted with interest an article which appeared on page 123 of the April 14, 1945 issue of ELECTRICAL WORLD on "Temperature Rise Tests on Submarine Cable" by G. Leslie Hill.

Mr. Hill concludes in this article that the thermal resistivity of the mud appears to be a function of the depth below the bottom. The thermal resistance of the cable does increase with the depth it is buried. However, this is not necessarily an indication that the specific resistivity of the mud varies. An examination of the temperature rise of armored cable as calculated by the usual formulas for buried cable with a uniform thermal resistivity of the earth result in temperature rises which check the measured curve obtained by Mr. Hill.

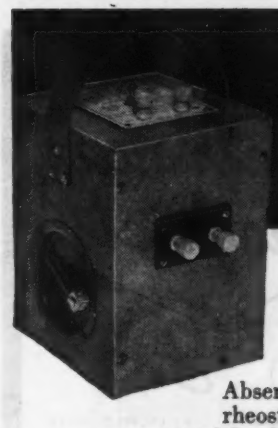
The attached drawing shows the curve from Mr. Hill's article. The


TEMPERATURE RISE OF CABLE ARMOR
DEPTH OF MUD OVER CABLE INCHES
X = TEST VALUES
O = CALCULATED VALUES
T = 60Q0S.ρ × LOG 2L/D
T = TEMPERATURE RISE
Q = NUMBER OF CONDUCTORS IN CABLE
ρ = THERMAL RESISTIVITY OF MUD=45C/WATT/CM
L = DEPTH TO CENTER OF CABLE (INCHES)
D = DIAMETER OF CABLE (INCHES)

EFFECT OF DEPTH of mud on temperature rise of buried submarine cable

points marked with crosses are actual values measured by the diver from which Mr. Hill's curve was drawn. The points marked with circles were calculated on the basis of the standard formula for buried cable using a thermal resistivity for the mud of 45 thermal ohms per cm³. It will be noted that these points are very close to the actual curve which would seem to indicate that this formula applies for this type of installation as well as for the usual buried installation. This formula is, of course, based on the mud having uniform thermal resistivity and the temperature rise at the greater depths is due to the longer heat path rather than to any change in thermal resistivity.

It will be noted that we used a value of 45 thermal ohms per cm³ to obtain these calculated values. This is lower than we would ordinarily use for such



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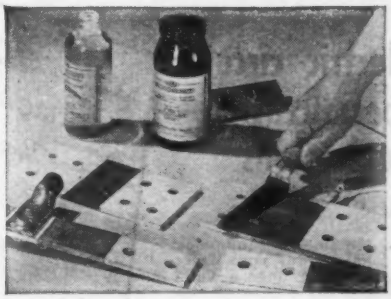

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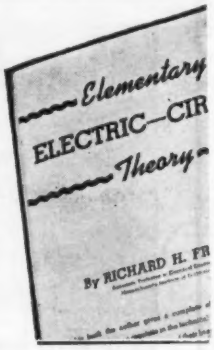

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Associate Professor of Electrical Engineering, Massachusetts Institute of Technology

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2. Resistance Networks
3. Basic Alternating-Current Concepts
4. Use of Complex Algebra
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6. Nonsinusoidal Waves
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calculations as we have been using a value of 60 thermal ohms per cm³ for cables buried in mud. There are two possible explanations for this difference, probably the most logical being that the cable actually is operated at less than 100 percent load factor. Thus, the actual temperature rise should be calculated by multiplying the thermal resistance by the loss factor to obtain the apparent thermal resistivity of the mud. For example: if this cable had been operating with a 75 percent loss factor it would be equivalent to a thermal resistivity of 60 thermal ohms per cm³ multiplied by this loss factor of 0.75 which again brings us back to an apparent thermal resistivity of 45 thermal ohms per cm³. We do not know the loss factor on this particular cable at the time of the test, and this would be of interest in determining the actual thermal resistivity of the mud. This, however, will not affect the shape of the curve and by the substitution of the proper value for apparent earth resistivity, the calculated curve will coincide with the actual measured value which we believe is an excellent indication of the reliability of this formula for calculating temperature rise of submarine cables buried in the bottom of the river.

R. C. Waldron
Assistant to the Chief Engineer
The Okonite Company
Passaic, New Jersey

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Crane-Boom Contacts

To the Editor of ELECTRICAL WORLD:

A number of workmen have been electrocuted on various construction jobs in the U. S. when they touched the steel frame of rubber-tired cranes whose booms had accidently touched bare high voltage wires.

To reduce this hazard, a chain may be fastened to the steel frame and allowed to drag on the ground. This ground connection should usually cause a flash and trip-out at the instant the crane operator touches the wire with the boom.

Accidents of this type are fortunately rare, yet at least three men have lost their lives this way in the past five years.

R. K. Templeton
Riverside, Ill.

•

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BOOK REVIEWS

The Coming Age of Rocket Power. By G. E. Pendray. Published by Harper & Bros., New York. 244 pages, illustrated. Price $3.50.

Except for the final four or five chapters the book is nowhere near as prophetic or interplanetary as the title might imply to some. On the contrary the author, secretary of the American Rocket Society, traces the evolution of jet propulsion from the 13th century to the buzz-bomb and our own bazookas and rocket ships. Avoiding mathematics and thermodynamic formulation and rigor the treatment does, however, record in good, understandable language the mechanical and energy factors which made the progress so slow until war spurred the technology. Engineers who are keeping an eye on the gas turbine will find little direct mention of it here, but much about nozzles, alloy temperatures, flame velocities, disposition of compressors, fuel, etc. that shows how the combustions in each are overcoming cognate problems.

Practical Management Research. By A. R. Wiren and Carl Heyel. Published by McGraw-Hill Book Co. 218 pages, illustrated. Price $2.50.

One of a series on industrial organization and management guided by industrial executives, this number discusses the planning, execution and interpretation of studies aimed at getting facts and guidance instead of relying on intuition and hunches. The approach is along the lines of fundamental factors rather than one of selecting cases for restricted treatment. The effort is placed strategically in the organization pattern. Control techniques are discussed and systematic procedure detailed. Great emphasis is placed on finding why some business program went wrong and what can be done to keep a pending one on a successful path. Specialists contributed final short chapters on specific aspects of the management research problems.

Television Programming and Production. By Richard Hubbell. Published by Murray Hill Books, Inc., New York. 207 pages, illustrated. Price $3.00.

Television is a post-war load potentiality for the electric utilities. Some of potentiality rests on the capacity of prospective "vidiences" to absorb the sets and some depends on the type of programs offered and how well they are organized and supervised. Criteria for acceptable television reception are here discussed along with sources of interference. Differences from movie and radio are analyzed from standpoints of performers, studio and directors. Requirements of camera and photographic technique, composition of scene, editing of film, appropriateness of lighting, the companion audio and music are canvassed in a spirit of promoting the kind of program the public will patronize, at home or in the movie theater.

The Bogey of Economic Maturity. By George Terborgh. Published by Machinery and Allied Products Institute, Chicago. 263 pages. Illustrated. Price $3.

Formerly associated with the Brookings Institute and the Federal Reserve Board the author here, seconded by the publishers, batters down the stubborn New Deal pessimism typified by perennial pump-priming and eternal deficits. Picking to pieces the theory of a levelling population, the passing of frontiers, the lack of wholly new industries, the conclusion is that there is no reason why courage should not result in spending that stimulates rather than in oversaving that debilitates and stagnates. Equally refuted is the proposal of the pessimists that excess savings should be corralled by the tax route and spent by the bureaucrats to prime the pump. The attempt to drag in frontiers that vanished 50 years ago is called dressing a scarecrow. The true crux of the economic-stabilization objective is to achieve a salutary relationship between savings and investment. Viewed with complacency is the tendency of capital consumption to rise relative to capital formation when the rate of increase of the latter slows up, as with flattening population. The analyst sees a trend toward less financial self-sufficiency of corporations.

Power System Stability. Vol I Steady State Stability. By S. B. Crary. Published by John Wiley & Sons, New York. 291 pages, illustrated. Price $4.00.

Literature of stability analysis has been increasingly voluminous and widely scattered. Here it is digested and compiled in logical evolution for service to the growing technical group which wrestles with maintenance of stability of systems sensitive to disturbances. The author has drawn upon his General Electric associates and upon utility contributors to render an authentic, documented and practical exposition, founded on material in part previously unpublished. Machine characteristics and line limits (including economic criteria) lead up to a summarizing chapter on system design. Appendices explain the use of per-unit representations and the computation of the inerted constant. The ensuing volume will treat transient stability.

Electromagnetic Engineering. Vol. I. By R. P. W. King. Published by McGraw-Hill Book Co. 580 pages, illustrated. Price $6.00.

This volume is on fundamentals essential to a grasp of the fields of antennas and wave guides, wave propagation and electronic transit-time as developed in the subsequent volumes. Treatment is geared to absorption by graduate students and advanced seniors but good success is reported with accelerated war-courses. Surface phenomena and magnetization are explored mathematically and by models, with curls employed to express mean densities. What constitutes conductivity is next assayed before discussing fields of force, resonance, impedance, and radiation resistance. Appendices deal with differential operators, function tables, dimensions, units and electronic-realm symbols.

Piping Handbook. By Sabin Crocker. Published by McGraw-Hill Book Company. 1376 pages, illustrated. Price $7.00.

This fourth edition (first in 1930) contains new chapter sections on hydraulic power transmission, refrigeration piping and corrosion as well as considerable expansion of the prior subject matter on flow of water in pipes. Early chapters continue to treat the theory and empiricism of fluid, gas and vapor behavior, metallurgy of pipe metals, the standards for pipe and fittings, welding, heat insulation, stress, leak, heating systems, piping for fire protection. The corrosion section presents a valuable guide to the selection of piping to withstand the action of a large number of the liquids and chemicals of industry. New emphasis is placed on the use of Reynolds-number solutions for fluid flow. These brief mentions are in themselves indicative of the broad and authoritative usefulness of the revised handbook.